bacillus diphtheriæ, the bacillus acidi lactici, the bacillus typhosus, the bacillus coli, the bacillus dysenteriæ, a paratyphoid bacillus, the micrococcus pyogenes aureus and the cholera spirillum—are destroyed by the process.

2. Sporing forms—viz., the bacillus anthracis, the penicillium glaucum, the bacillus subtilis, and the bacillus mycoides—are not destroyed by the process although reduced in numbers, the inference being that the vegetative forms are destroyed but the spores are not destroyed.

3. Although the heating *per se* may be efficient in destroying certain non-sporing organisms—e.g., the bacillus diphtheriæ, the bacillus typhosus, and the cholera spirillum—it is not so in all cases. Thus in one experiment the bacillus typhosus and the micrococcus pyogenes aureus survived the heating when no peroxide was added, and under similar conditions the bacillus acidi lactici survived in the two experiments in which this was tested.

4. The same fact is strikingly shown by the effect of "Buddeising" on the natural milk—i.e., the milk without added micro-organisms. The reduction in numbers effected by heating alone is far less than with "Buddeising."

5. "Buddeised" milk is practically indistinguishable from untreated milk in taste, odour, appearance, and in the rising of the cream. No increase in acidity is caused by the treatment.

6. "Buddeised" milk will keep perfectly sweet and apparently unaltered in odour, taste, and appearance for at least from eight to ten days in hot weather and for a still longer period in cold weather.

7. In milk obtained in the ordinary way without *special* precautions the micro-organisms are reduced by the Budde process over 99·9 per cent. In the milk kept at room temperature the small residuum of living micro-organisms multiplies daily and ultimately (after from 12 to 14 days) may cause the milk to go bad.

8. The distribution of the "Buddeised" milk in closed bottles is in itself a great improvement on the routine system that obtains in this country of distribution in open vessels.

9. The method excludes all possibility of adulteration of the milk by the vendor before it reaches the consumer.

10. Properly carried out, the whole of the added hydrogen peroxide is decomposed at the end of the process and no trace of it can be detected in the treated milk.

If, as I am informed, the Buddeised milk can be produced without necessarily raising the price to the consumer above the ordinary rates, and if the nutritive qualities of Buddeised milk are unimpaired, of which there seems to be good evidence, the process appears to have a great future before it for infant, child, and invalid feeding and in the treatment of gastro-intestinal disorders.

In conclusion, I have to thank Mr. Richard Rythen of Broad Street House, London, E.C., who is introducing the process into this country, and Mr. P. Monrad, chemist to the Danish Budde Company, for their assistance in carrying out the above work.

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TWO CASES OF LEUKÆMIA TREATED BY THE ROENTGEN RAYS.

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AS the effect of the Roentgen rays on leukæmia is attracting considerable attention at the present time I have thought that some notes of two of my patients suffering from this disease and undergoing this form of treatment may be of interest. Neither case is represented as being complete, as treatment is being continued at the present time.

CASE 1.—The patient, a widow, aged 50 years, had complained for about four months of progressive weakness accompanied by increasing enlargement of the abdomen; she had been losing weight and complained of sleeplessness. She had been previously a very healthy woman but had suffered from malarial fever contracted in Malta (Malta fever ?) and also had suffered from sore throats. She had had three children, all of whom were living and healthy. In July, 1905, a diagnosis of leukæmia was made. At this time the patient was very weak and was rapidly getting worse; she complained of great pain and tenderness over the region of the spleen. Her temperature ranged from 99° to 100° F. in the morning and in the evening from 100° to 103°; she also had occasional rigors. Her spleen was found to be enlarged considerably and reached beyond the middle line; the lower margin could not be felt above the pubes. A blood count taken on July 26th resulted as follows: erythrocytes, 3,047,520 per cubic millimetre; and leucocytes, 400,147 per cubic millimetre, giving a ratio of 1 white to 7·6 red corpuscles. A differential count was not taken. X ray treatment was at once commenced and carried out daily, Sundays excepted. It consisted of ten minutes' exposure of the splenic area, five minutes' exposure of the sternum, and ten minutes' exposure of the knees with a hard tube, taking about two to two and a half milliampères on the secondary, the tube being about 12 to 15 inches from the skin. The patient had also intramuscular injections of arsenic in full doses; these were discontinued on Sept. 15th.

Blood counts were taken from time to time by independent observers. On August 1st the pain in the region of the spleen was much relieved and the patient slept much better. On Sept. 6th the general health had much improved and the patient declared herself as feeling altogether better. Her temperature was now rarely above 100° in the evening. On the 16th treatment was temporarily discontinued. She went to the country, returning on Oct. 3rd much better in general health. Daily treatment was again resumed. On Nov. 8th treatment was again interrupted for 14 days, being resumed on Nov. 23rd. Treatment daily from Nov. 23rd to Dec. 8th showed a further drop in the number of leucocytes from 72,300 to 32,200 per cubic millimetre. The patient's general condition is still improving, her weight has increased, and the size of the abdomen has diminished. The spleen is much smaller, reaching now to one inch to the left of the umbilicus and one and a half inches above the pubes.

Daily treatment is being continued and the following table illustrates the results of treatment to the end of December, 1905:—

Date.	Ratio of white to red blood corpuscles.	Hæmoglobin (per cent.).	Red blood corpuscles (per c mm.).	White blood corpuscles (per c.mm.).	Polymorphonuclear cells (per cent.).	Myelocytes (per cent.).	Other forms (per cent.).
1905							
July 26th	1 to 7·6	60	3,047,520	400,147	—	—	—
August 2nd	1 to 6·7	—	3,085,000	461,548	—	—	—
,, 13th	1 to 6·3	57	3,150,000	499,000	40·0	39·2	20·8
Sept. 6th	1 to 7·5	—	3,200,000	426,000	—	—	—
,, 16th	1 to 13·1	—	3,810,000	290,625	—	—	—
Oct. 12th	1 to 20·7	—	4,696,000	226,800	45·0	19·0	3·6
,, 27th	1 to 34	79	3,975,000	117,000	—	—	—
Nov. 9th	1 to 63	81	4,550,000	72,300	51·2	34·8	14·0
Dec. 8th	1 to 141	—	4,550,000	32,200	—	—	—

CASE 2.—The patient is a young married woman, aged 23 years. A brief account of her illness and treatment has already been published.[1] The patient had suffered from epistaxis from childhood and had rheumatic fever at the age of 18 years. She was confined on Feb. 17th, 1904, and subsequently had severe post-partum hæmorrhage which was with difficulty stopped. On April 1st she noticed some swelling of the abdomen which continued to increase. She lost flesh rapidly. Menstruation had not reappeared after her confinement. She was admitted into Charing Cross Hospital on Sept. 10th, 1904, under the care of Dr. J. Mitchell Bruce. She was at this time very anæmic in appearance, her tissues were wasted, and the abdomen was greatly increased in size. Her spleen reached downwards to the pubes and extended laterally to within half an inch of the middle line. Its outline was ill defined; it was somewhat tense and on deep pressure was slightly tender. The urine was acid, of specific gravity 1022, and contained no albumin. Auscultation of the heart discovered well-marked aortic and mitral regurgitation. Blood examination showed: red blood corpuscles, 2,300,000 per cubic millimetre; white blood corpuscles, 1,440,000 per cubic millimetre; myelocytes, 34·4 per cent.; polymorphonuclears, 52·5 per cent.; eosinophiles, 6 per

[1] A case of Splenomedullary Leucocythæmia treated with X Rays, Medical Electrology and Radiology, April, 1905.

cent.; nucleated red corpuscles, 6 per cent.; poikilocytosis was fairly marked; hæmoglobin, 34 per cent. The temperature on the average fluctuated between 98° and 100° F. On Oct. 9th the patient was still unable to leave her bed and it was decided to try x ray treatment. Ten minutes' exposures with a hard tube were given over the splenic area only every day until the end of October with an interval of six days' rest after the first nine days of treatment. On Oct. 16th she was able to get up and on the 28th was discharged from hospital. A blood count taken on this date resulted as follows: red blood corpuscles, 3,020,000 per cubic millimetre; white blood corpuscles, 232,000 per cubic millimetre; and hæmoglobin, 37 per cent. Poikilocytosis was much decreased and the proportion of myelocytes was apparently diminished. The spleen was smaller, its lower edge being now one and a half inches less towards the pubes, and its whole outline was better defined.

Since her discharge the patient has been able to walk to the hospital and to attend for treatment as an out-patient. Exposures of ten minutes over the splenic area, sternum, and knees were given each day on alternate weeks. In December menstruation reappeared and was afterwards regular. In January a blood count showed: red blood corpuscles, 3,862,000 per cubic millimetre; white blood corpuscles, 93,000 per cubic millimetre; and hæmoglobin, 44 per cent. In February another count was taken as follows: red blood corpuscles, 4,750,000 per cubic millimetre; white blood corpuscles, 42,200 per cubic millimetre; and hæmoglobin, 46 per cent. The spleen was now much smaller. The patient had increased in weight, was looking better, could walk without fatigue, and could attend to her household duties. From this time on, however, she did not come regularly, her attendances as an out-patient numbered from five to nine each month, and although her general condition appeared to be satisfactory and she could easily perform her duties at home the result of blood examinations show that the improvement reached has not been quite maintained.

The following table shows the differential blood count at various dates:—

Date.	Ratio of white to red blood corpuscles.	Hæmoglobin (per cent.).	Red blood corpuscles (per c.mm.).	White blood corpuscles (per c.mm.).	Polymorphonuclear cells (per cent.).	Myelocytes (per cent.).	Other forms (per cent.).
1904							
Sept. 10th	1 to 1·6	34·0	2,300,000	1,440,000	52·2	34·4	13·4
,, 30th	1 to 2·1	32·5	2,360,000	1,110,000	—	—	—
Oct. 28th	1 to 13	37·0	3,020,000	232,000	57·4	30·2	12·4
1905							
Jan. 6th	1 to 40	44·0	3,842,000	96,000	61·0	27·0	12·0
Feb. 21st	1 to 112·5	46 0	4,750,000	42,000	63·0	23·0	14 0
April 4th	1 to 65	—	4,280,000	97,700	65·25	14·25	20·5
July 14th	1 to 22	70·0	4,040,000	183,000	—	—	—
Sept. 9th	1 to 20·6	70 0	4,170,000	202,000	59·3	18·3	22 4

In Case 1 it is to be noted that treatment has been systematic and regular from the beginning and that a steady and progressive rate of improvement is being maintained up to the present time. The general health is better, the spleen is smaller, the temperature is normal, the number of red corpuscles has increased, and the number of leucocytes has fallen from 400,147 to 32,200 per cubic millimetre. The ratio of white to red corpuscles has decreased from 1 to 6·3 to 1 to 141. The proportion of polymorphonuclear cells has risen and the proportion of myelocytes has fallen. Thus in all the characteristic phenomena of the disease there is marked improvement. What the final issue of a case of this type will be it is of course impossible to say, but from a study of the reported cases[2] there is ground for hope that with increased experience in treating this disease improvements in technique will be followed by considerable improvements in the attained results.

The second case is specially interesting as the patient was at first exceedingly ill and presented all the appearance of an extremely grave case of leukæmia. Whilst treatment was regularly and systematically carried out the improvement was very striking. The bedridden patient was so far restored to health as to be able to resume control of her domestic duties and to walk to and from the hospital for treatment as an out-patient. The number of leucocytes was reduced from 1,440,000 to 42,200 per cubic millimetre and the ratio of white cells to red from 1 to 1·6 to 1 to 112·5. The number of red corpuscles increased from 2,300,000 to 4,750,000 per cubic millimetre. The patient gained considerably in weight and strength and the size of the spleen diminished. As so frequently happens, however, in hospital practice the patient, being in a condition once more to attend to her work at home, became careless and infrequent in her attendance and her clinical chart showed well how infrequent exposure to the x rays was accompanied by a slow but very perceptible increase in the number of leucocytes and a proportionate decrease in the total of red cells.

Theories as to the source of the curative effect of the x rays in leukæmia are no doubt interesting, but our knowledge of their therapeutic action must be indefinite until something more is known of the etiology of the disease. It is often assumed that the disease is microbic or parasitic and the general opinion at the present time seems to be that the x rays are non-bactericidal. I would like to point out, however, in this connexion that it is possible that the density to the x rays of the glass of which the culture tubes are made has not been sufficiently considered. Lead glasses are very dense to the rays and the glass used in the construction of the Crookes's tubes has to be specially prepared. The x rays therefore may yet be proved to have some bactericidal properties. It is possible also that some or all of the improvement noticed in the treatment of these cases may be due to some other emanations from the Crookes's tube and not to the x rays. Leucocythemia may be, of course, merely an exaggerated leucocytosis—i.e., an increased formation of leucocytes—or it may be an alteration in the metabolism of cells formed in the ordinary way, which leads to their prolonged life in the body and so to their increased number. The analogy between this disease and sarcoma has been frequently pointed out and the effect of the x rays upon new cell formation of a malignant type is well known. The curative effect of the x rays may be then another instance of their power over the growth of tumour cells.

It has been stated that a too rapid diminution of leucocytes in leukæmia is associated with the production of toxin and the exhibition of high temperature. High temperature has been associated with this disease always and was described long before the introduction of the x ray treatment. The patient in the first case had rigors even before treatment was commenced. In this case also a drop in the number of leucocytes of 40,000 per cubic millimetre was noticed in 11 days without any ill result. My own experience has been that decrease of white cells is invariably accompanied by marked improvement in the general condition of the patient.

The effect of x rays upon pigment is interesting. Case 1 had some pigmentation before treatment by the x rays was commenced. The pigmentation was general and was probably due to arsenic which had been previously given. The patient stated that she was very susceptible to sunburn. After exposure of the spleen to the rays had been carried out for some time the skin over the area became quite negroid in appearance. Some desquamation has taken place since felt has been used and the skin is now much lighter in colour. The great difficulty in this form of treatment is the production of a dermatitis from continuous exposure to the rays. This has the disadvantage of interrupting treatment and is painful and troublesome to the patient. In many of the cases that have been reported it is noticeable that this incident has interfered with the continuance of treatment.[3]

It is a striking fact that in most of the cases of dermatitis arising in x ray workers the changes in the skin are often limited to the hand and wrist and are not seen beyond the margin of the coat sleeve. This circumstance suggested to my mind the question whether dermatitis could not be eliminated by protecting the skin by layers of substance penetrable by the rays, such as linen, cloth, &c. In Case 2 one thickness of linen (table cloth) was interposed between the tube and the skin. Since this has been done there has been no suggestion of dermatitis and treatment has certainly not been hampered in any way by the use of the linen. In Case 1 four folds of felt, each one-eighth of an inch thick, were interposed at the time that the diminution of white cells from 72,300 to 32,200 per cubic millimetre was noticed in 11 days. In order to allow of

[2] The X Ray Treatment of Leukæmia, Ledingham and McKerron, THE LANCET, Jan. 14th, 1905, p. 71.

[3] Leucocythæmia treated by x rays, Brit. Med. Jour., July 1st, 1905.

larger dosage a heavy anode tube at a distance of 12 inches from the patient was used with a 22-inch coil, the amount of current on primary being 4 ampères, 100 volts. In addition to this, at the end of ten minutes' exposure the tube was given as much current as it would stand for one minute. I think the rapid decrease in the white cells just mentioned was due to the extra amount of electric energy used and yet no dermatitis or rise in the body temperature was noticed. On the contrary, there was an extraordinary improvement in the patient's condition generally.

With such large doses of rays as mentioned above, if given in the ordinary way, a very severe dermatitis would undoubtedly ensue very quickly, with possibly severe ulceration of the skin. By my method of protecting the skin I hope to be able to eliminate the burning effects to some extent and at the same time to obtain the fullest benefit from the rays when used as a therapeutic agent. It has been frequently stated that dermatitis is not the product of the x rays but that it is due to the direct action of the high-tension current used to produce the rays. My experience so far strongly supports this contention. The use of protective layers over the skin in these cases tends to illustrate the benefit that may be obtained in a similar way in other diseases in which the Roentgen rays are used and in which the production of a dermatitis is not desired. I hope experiments in this direction will be made and the results noted, as if increased dosage without dermatitis can be obtained a much larger field of usefulness for the rays will be opened up.

The effect of continued irradiation of other organs in relation to the spleen is not as yet accurately known. So far no case has been reported in which any deleterious effect has been noticed. The indefinite manner in which the dosage of the rays is of necessity stated in reporting the above cases is a matter for regret. It has been claimed that a satisfactory method of measuring the radiant energy has been discovered. The amount of rays produced in a Crookes's tubes is, however, dependent upon a number of factors, all of which are not within control. The tubes vary so enormously in efficiency that the quantity of current used, as indicated by a milli-ampère-metre on the secondary of the coil, can give no idea of the amount of rays produced, and it is well known that the penetrative power of the rays alters very considerably during an exposure of any length of time. The measurement of the amount of rays produced and of their penetrative power is a problem which still awaits solution.

Progress in radio-therapy has been so rapid that it is difficult to realise all that has already been accomplished. With such results, however, as are already obtained in leukæmia and in other diseases it is difficult to be anything but optimistic with regard to the future. Increased accuracy of dosage, improved methods of administration, and the elimination of all possible elements of risk to the patient are all points in which we may certainly expect advances to be made, with an almost certain expectation of a still wider field of usefulness for the Roentgen rays.

Weymouth-street, W.

"INTERRUPTED CIRCULATION" AS A THERAPEUTIC AGENT,

WITH ILLUSTRATIVE CASES OF RHEUMATOID ARTHRITIS.[1]

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[AFTER a few preliminary remarks and a brief allusion to his previous paper[2] under the same title, containing a reference to Harvey Cushing's[3] successful use of the tourniquet in a case of Raynaud's disease, and to George Oliver's[4] pioneer work in the study of tissue lymph in its relation to the circulation, Dr. Ewart commenced the main portion of his paper by describing the technique employed, in the following words :—]

A brief account of the procedure (which is essentially the same as in operations) had better precede the notes of the cases in which it was applied. In the absence of an Esmarch's tourniquet the simplest substitute is indiarubber tubing of suitable thickness, which is tightened round the limb in single or double loop outside a slight protecting pad. The tube can either be simply drawn tight, both ends of the loop being held, or else coiled over itself to any degree of tightness. As a preliminary the limb is to be rendered anæmic, the patient being in the reclining posture. In many instances the profound anæmia obtained by Esmarch's bandage need not be resorted to, though it is an essential for the best results, but the raised limb must be squeezed empty and kept elevated until after the application of the tourniquet. The relative duration of the constriction will also influence the result and will need to be varied according to the nature of the case. In my hands the shortest has been 30 seconds and the longest from three to five minutes. I have not exceeded six applications at one sitting, with a duration of two minutes each and with intervals of from one to two minutes. Three applications at each sitting may suffice in most cases and two sittings daily may be desirable. It is important to liberate the artery suddenly; and a distinct advantage is gained by lowering the limb into the vertical position, if this can conveniently be done, just before removing the ligature. With sufficient care the risk of any damage from excessive pressure at the seat of ligature is easily avoided. None of the cases hitherto treated have presented the slightest complication referable to the skin, to the vessels, or to the nerves. It need hardly be mentioned that inflamed or tender nerve trunks are an absolute contra-indication just as much as senile and calcified arteries.

THE CASES.

The cases belong to the following groups: (1) Subacute, subpyrexial synovitis, persistent or relapsing, in young subjects of rheumatic tendency; (2) deforming soft puffy nodular arthritis in women, with chronic quiet intra-articular and peri-articular effusions and thickenings; and (3) late massive arthritic thickenings, with articular rigidity or with much stiffness. The treatment was suspended in one case only—that of a stout, florid man of gouty temperament with chronic effusion and synovial thickening of the right knee of eight months' duration. As no visible reduction of the swelling was obtained after three sittings the further application of the method was postponed till other forms of treatment had been given a trial.

[Cases 1, 2, and 3 were those of acute or subacute relapsing rheumatoid arthritis, all in young women. They were treated in June and July, 1905, and all improved while under treatment; since their discharge, however, they have not been seen again.]

CASE 4. *Chronic rheumatoid condition, with acute painful seizures of fixation of joints and muscles.*—The patient, an unmarried female, aged 52 years, had always been healthy, in spite of a gouty tendency, but of late years she had been increasingly liable to acute rheumatoid swellings of the joints and stiffness of the muscles. In the autumn she had quickly recovered from her symptoms during a stay abroad; on returning to London she was seized the same night and rendered quite powerless by stiffness and pains, from which she slowly recovered. Her present attack, the worst she had ever had, began in April, 1905. When she came under treatment in June the very severe pain which she had suffered, apparently from acute neuritis, over the inner aspect of the head of the left tibia was less intense, but there were great aching and tenderness of the swollen left knee and of both hands, the shiny skin of which seemed to be too tight for the enlarged and stiffened phalanges. The temperature was normal or only slightly elevated at times. General treatment by saline laxatives, by colchicum and mercury, and local applications such as in particular of the compound liniment of iodide of potassium, did good. Neither these measures, however, nor massage made so marked and rapid an impression upon the stiffness, the swelling, and the pain as the treatment by interrupted circulation which was applied for upwards of three weeks, and the efficacy of which was demonstrated by limiting its employment to the left arm first, then to both arms, before it was applied to the left thigh. Great relief was obtained in the three limbs, with considerable though not complete loss of swelling. The patient was then sent to Aix to consolidate her recovery.

CASE 5. *Chronic deforming rheumatoid arthritis with effusion and rigidity, but without ankylosis.*—The patient, a married woman, aged 37 years, thin, pale, and nervous, of

[1] A paper written in July, 1905, and read before the Royal Medical and Chirurgical Society on Jan. 23rd, 1906.
[2] THE LANCET, August 13th, 1904, p. 442.
[3] Journal of Nervous and Mental Diseases, November, 1902.
[4] The Oliver-Sharpey Lectures on Recent Studies on the Tissue-Lymph Circulation, THE LANCET, April 30th (p. 1175) and May 7th (p. 1262), 1904.