increases in strength, *ceteris paribus*, with the number of its affluents, so do simultaneous and concurrent *circuli vitiosi* exert a cumulatively potent effect. The result of such concurrence may often be observed both at the bedside and on the *post-mortem* table; indeed, a large proportion of deaths are the direct consequence of such cumulative action. The analysis of a few disorders may emphasize this aspect of disease; the procedure once understood can

Concurrent Circles in Cardiac Failure.

readily be applied in other conditions. We shall select as illustrations:

- (1) Cardiac failure.
- (2) Pulmonary tuberculosis.
- (3) Obesity.
- (4) Habitual constipation.*

A tabular arrangement will give the most complete survey of the morbid processes in operation, although the graphic representation of the circular process will leave a more durable impress on the memory than printed words can do.

Such tabular statements allow the best panoramic survey of the hostile forces that have been mobilized; and yet they do not reveal all the intricacies of disease. Each of the injurious reactions may in its turn give birth to other circling eddies or raging whirlpools. Such is the result of

* Fuller details of these reciprocally acting processes will be found in *Vicious Circles in Disease*, by J. B. H.

the intimate and far-reaching correlations existing in highly specialized organisms.

But a still more impressive, because more living, representation of the subtle interrelationships is secured by actually depicting the circular process, as has been done in the two accompanying diagrams. The limitations of space and of typography forbid an exhibition of the entire series of complications, but a sufficient number have been given

Concurrent Circles in Habitual Constipation.

to illustrate the principle. Any reader can, on a larger page, supplement the list.

There are many disorders that can be studied by this method, and it will be found a profitable exercise to resolve them into their constituent circular processes. Neurasthenia, Graves's disease, dyspepsia, and anaemia may be suggested as eminently suitable for the purpose.

Happily the circular processes mentioned above are never simultaneously present. The alert physician, however, will be on the look-out for their development and be prepared to adapt his therapeutics accordingly.

From the dawn of medicine the primary reactions of a disorder have absorbed universal attention, while the reciprocal influence of those reactions on the primary disorder have, *mirabile dictu*, been almost wholly neglected; and yet such influence may be of immeasurable import as regards the evolution, the progress, and the termination of disease.

THE X-RAY TREATMENT OF HYPERTHYROIDISM.

BY

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As a radiologist with over fourteen years' continuous clinical experience in the x-ray treatment of hyperthyroidism, I can bear witness to the undoubted value of x rays in this condition.

By the term "hyperthyroidism" I mean all types of thyroid activity in which there is excessive or disordered thyroidal secretion. The term therefore includes a simple mild hyperthyroidism without any macroscopic enlargement of the gland, up to an acute and severe hyperthyroidism with all the accompanying physical evidences and symptoms of Graves's disease. Three out of every four female patients in whom the disease has not lasted long enough to produce myocardial degeneration recover their general health and good functional activity of the gland; I stress the word "female" because in my experience males do not as a general rule respond so readily to the treatment. In some cases which fail to respond to radiation I believe other endocrine glands are probably involved; it is in any case wise to include the area of the thymus gland in the field of radiation. The intimate association of the ovarian and thyroidal functions is well known; and it is interesting to learn that Dr. C. M. Wilson and Mr. A. W. Bourne of London found speedy relief of symptoms

from x-ray applications to the thyroid in women suffering from so-called functional menorrhagia—that is, a type of menorrhagia in which there were no pelvic signs to account for the loss and which cases generally resisted curettage or other treatment.¹

I have found determination of the basal metabolic rate useful in the diagnosis of doubtful cases of hyperthyroidism, and I do not advocate the radiation of doubtful cases unless the basal metabolic rate has been carefully estimated and is definitely in favour of the condition being one of hyperthyroidism. It is also useful as a guide to the progress of a case, and should be more systematically undertaken.

Although the enlarged thyroid gland may not be reduced in size by radiation, and although the exophthalmos frequently remains, the pulse rate becomes slower, and the breathlessness, tremors, excessive perspiration, sleeplessness, and the general malaise gradually disappear and the patient gains in weight. The weight goes up as the pulse comes down, and a careful record of these factors serves as a practical guide to progress.

I was recently astonished to read Mr. A. J. Walton's statement: "I have no evidence that x rays can overcome hyperthyroidism even to the point of myxoedema, as is sometimes claimed; but, on the other hand, I have never found that it makes a future operation more difficult on account of the fibrosis. If I had evidence that it produced any fibrosis I should believe that it would control the hyperthyroidism." I welcome his statement that he has not found operative treatment rendered more difficult by

fibrosis caused by previous radiation treatment, but it is difficult to reconcile this statement with the diametrically opposite expressions of other surgeons. I think it is regrettable that surgeons, who have necessarily only a limited experience of the effects of x-ray treatment on the general health of patients suffering from hyperthyroidism, should publish opinions which are in direct contradiction to the general experience of men daily carrying out such treatment. Radiologists do not dispute the undoubted good results obtained by operative measures because occasionally patients present themselves for radiotherapy after operation has failed to cure the condition.

Having observed the undoubted value of carefully applied x-ray treatment in Graves's disease, I consider that unless radiotherapy has been given a fair trial and has failed to bring about a definite improvement in the condition, the operative treatment of Graves's disease ought not to be undertaken in view of the risks entailed. In Graves's disease, as in other diseases, the best results are obtained by team work, and close co-operation between physician, surgeon, biochemist, and radiologist is essential.

I have found the following technique give good results. I use a Coolidge tube, backing up a 9-inch spark-gap, and give either a two-thirds or three-fourths Sabouraud B, measured after filtration through 2 mm. aluminium, as a dose to each side of the neck once a week. Only one side of the gland is radiated at one sitting, as in some cases there may be a temporary increase of the hyperthyroidism if a heavy radiation is given and both sides are radiated simultaneously. I prefer the fractional dose, spread over a course of twenty to thirty radiations, to a massive dose given, as at Erlangen, in only one or two sittings. The latter method may have the advantage of quicker results, but is, I think, risky. In a case of true Graves's disease the average number of radiations necessary to produce good results is about twenty-five, and although in some cases treatment at intervals of three to six months, or even a year, may be required, yet, in my opinion, the period of the disease is shortened by radiation treatment. I think, moreover, cases of mild hyperthyroidism should have a course of x-ray treatment as a prophylactic measure against the development of true Graves's disease, as I believe that the full development of the condition has been prevented by this course of action in some cases which have come under our care.

Illustrative Cases.

In about 75 per cent. of all the cases treated, I believe great improvement occurred, and about 50 per cent. have ceased to have symptoms of hyperthyroidism. Only one patient developed any serious skin lesion; this patient was treated about twelve years ago before our technique was as good as it is to-day.

The following notes on a few cases are typical of the results obtained in 50 per cent. of the cases submitted to radiation treatment.

1. A severe case of Graves's disease in a female who weighed 8 st. $\frac{1}{2}$ lb. Treatment commenced on March 1st, 1922, and continued to May 19th. Steady improvement in health resulted, and on July 4th the patient weighed 8 st. 10 lb.; all symptoms of hyperthyroidism had disappeared.

2. A patient with fourteen years' history and the usual symptoms, and pulse rate 135, commenced treatment on September 9th. By September 22nd improvement was noticeable, and by October 10th the pulse rate had fallen to 104. On November 28th the pulse was 92, and the treatment ceased on December 1st.

3. A very severe case of exophthalmic goitre in a female who was carried into my consulting room, unable to walk. The ankles were swollen, the pulse rate was 135-140. The patient was rapidly going downhill, and a grave prognosis was given by the physician in charge. She commenced treatment on May 9th, 1917, and improvement commenced on the 26th. On June 6th the pulse was 116; on the 13th a gain of 4 lb. in weight was recorded, and on July 2nd another 8 $\frac{1}{2}$ lb. gain coincided with a very marked general improvement. The swelling of the legs had disappeared by July 16th, and the patient was able to walk on the 19th. No more severe paroxysms of tachycardia occurred, and the treatment came to an end. Her improvement steadily continued after cessation of treatment, and early in 1918 she had completely recovered her health, and was working on the land.

4. A severe case of hyperthyroidism in a female, to whom treatment was given from February 2nd to April 20th, 1922. The weight in this case diminished during the treatment, but the general health gradually improved, and by August 31st she was

practically well. When seen in November, 1922, the patient had increased in weight and improved so much in appearance and health that we did not know her.

5. A severe case of Graves's disease in a male, with a very rapid pulse, and weight 9 st. 1 lb. He commenced treatment on July 2nd, 1917, and by August 13th had gained 7 lb. in weight. On August 27th there was a further gain of 4 lb., and on September 5th the pulse was 80. By September 24th the weight was 10 st. $\frac{3}{4}$ lb., the pulse 76, and there was very marked general improvement in health. After a few further treatments given in December the patient weighed 11 st., and returned to work on the railway.

6. A male with seven years' history of severe Graves's disease; thyroid very much enlarged; pulse 120; marked tremors and exophthalmos. Treatment commenced on December 29th, 1919. On February 5th, 1920, the pulse was 102; on April 7th it was 80, and there was a general improvement in health. Three courses of treatment were given between December 29th, 1919, and August 17th, 1920. The patient steadily improved in general health and the enlarged gland returned to an almost normal size.

We do not know how the x rays produce their effect and cure hyperthyroidism, but as the function of the gland apparently becomes normal again it is highly probable that, apart from any local action such as thickening of the intima of the blood vessels and an increase in the fibrous tissue elements of the gland, other changes occur which affect or modify the quality or quantity of the gland secretion. It must be borne in mind that radiating so vascular an organ as the thyroid may produce changes in the blood serum which may also influence the gland. I have only personally seen myxoedema produced in two cases of Graves's disease, and as in one of these cases only a very few radiations had been given and the other had received no more than the usual amount of radiation, it seemed highly improbable that the radiation was the cause of the myxoedema in either case. Both patients did exceedingly well under thyroid treatment. It is our practice to stop radiation before the heart frequency comes down to normal, as the effect of radiation is cumulative and continues for some weeks after actual treatment has ceased.

Some patients who have still symptoms of hyperthyroidism on completion of their first course of treatment present themselves some few months later without any symptoms of the disease. I have not found radiation treatment satisfactory in cases in which symptoms of hyperthyroidism have supervened upon an old large parenchymatous, adenoparenchymatous, or cystic goitre. These cases should be referred to the surgeon, especially if there is pressure on the trachea. If the condition of the patient precludes surgery radiation treatment must be tried, as improvement in the patient's general health sometimes occurs, although the gland is not obviously reduced in size.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, November 11th, 1922, p. 911.

AN ANTIDOTE FOR ARSENIC, BISMUTH, AND MERCURY POISONING.

BY

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ALL the larger venereal clinics and not a few practitioners are occasionally faced with the anxiety incidental to cases of arsenical jaundice and dermatitis, and more commonly with the problem of treating stomatitis due to bismuth and mercury. It is the purpose of this communication to draw attention to the value of intravenous injections of sterile solutions of chemically pure sodium thiosulphate in combating the toxic effects of these drugs.

A preliminary report in 1920 by P. Ravaut¹ was followed in 1922 by a more detailed account by McBride and Dennie,² whose clinical results, based as they are on seven cases of severe arsphenamin dermatitis, seem to me to justify their claims and to warrant trial on a more extensive scale.

Their conclusions, shortly stated, are that the course of the dermatitis is shortened from months to weeks; that intravenous injections of the salt are preferable to all other