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GLEANINGS FROM THE STORY OF THE THYROID GLAND.

AN ADDRESS DELIVERED TO THE SOUTH-WEST WALES
DIVISION OF THE BRITISH MEDICAL ASSOCIATION

BY

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THE accounts of the physiology of the thyroid gland and the surgery of goitre given in the textbooks of my early student days took less than three hours to read and study; it is, however, necessary to point out that this apparent cramming course was not so intensive as it sounds. In the index to the fourth edition (1883) of the standard *Textbook of Physiology* by Michael Foster there is no reference to the thyroid gland. Incidentally, it was in this year that attention was drawn in Switzerland to post-operative myxoedema, as will appear later from the very interesting note sent by my friend Dr. Albert Kocher in reply to a request to let me have an epitome of the work his father, the late Professor Theodor Kocher, had done as regards the subject-matter of my address to you. I am glad to recall that both Professor Theodor and Dr. Albert Kocher visited the area of our South-West Wales Division many years ago and saw examples of our thyroid troubles, to my edification.

On the question of the surgery of goitre I have to confess that for a few years after qualifying I deprecated operations except in emergency—in fact until I visited the great master and pioneer at work in Berne. This attitude, I may add, was due almost entirely to the teaching and practice at my school, for I, being imitative, had operated on a Gasserian ganglion and did an experimental decompression on acromegaly years before I felt justified in doing a thyroidectomy. My view was nurtured in my nonage by reading the seven pages devoted to diseases of the thyroid gland in the standard work *A System of Surgery* (Holmes, vol. 3, 1883), and was fortified years later by witnessing a brilliant surgeon attack a bronchocele and wallow in an operation masked with blood and many sponges, and constantly harassed by a Clover's bag—one special sponge was conspicuously held over the field to deliver fluid if necessary; later he descanted on its value should a gurgling sound be heard indicative of air

being drawn into one of the veins! He also pooh-pooled the adoption of an innovation which he flippantly described as a "cut-throat" incision.

When I witnessed the first Kocher operation performed by its originator with deliberation and care, without unnecessary spilling of blood, with unsurpassed surgical cleanliness, with non-variable speed, neither slow nor quick, but a safe "Kocher speed," I instantly became a convert. I was astonished and impressed with the novelty and value of the Kocher screen which completely safeguarded the field of operation from infection from the patient's mouth, from the anaesthetist, and from interested onlookers; the patient's hands also were secured from doing harm.

We re-read to-day, with gratitude to Professor Theodor Kocher, the nightmare which appeared under "treatment" in the *System of Surgery*, and obsessed so many like myself, knowing that it is now gone for ever; there we read such statements as that "fibrous bronchoceles are best treated by setons"; that "the best treatment for cystic bronchoceles is . . . tapping the cyst with a trocar and cannula, emptying it, injecting a solution of perchloride of iron (two drachms to an ounce of water) . . . to be repeated if necessary until suppuration is established"; and that "removal of a bronchocele is usually a grave operation . . . the danger of haemorrhage is considerable." Nevertheless, the volume contains shrewd clinical observations, and exhibits discernment and the true scientific outlook in not accepting as truth that which is not proven. For example, it is said:

"The endemic form of bronchocele, or goitre, occurs chiefly in association with cretinism and seems to have some hitherto unexplained connexion with geographical conditions . . . the cause commonly assigned—namely, the use of melted snow, or of water impregnated with calcareous or earthy particles—is unsatisfactory. . . . Although the Korrawurrees can get nothing but snow for some months in the year, they are not so subject to goitre as those who live at the foot of hills where there can never be any snow water."

The importance of this quotation will be seen when I come to discuss Professor Kocher's views as to the causation of goitre. From that time to the present the literature on thyroid gland and goitre has grown so voluminous that I can only attempt to bring to your notice a few gleanings, after reading to you the most valuable and interesting *aperçu* by Dr. Albert Kocher of his father's work on the subjects.

NOTES ON THEODOR KOCHER'S WORK ON THE THYROID GLAND.

BY

DR. ALBERT KOCHER.

From 1866 to 1872 Theodor Kocher was assistant of Professor Lucke in Berne. During that time Lucke performed ten goitre operations; of the patients nine died. Two years after having been elected Lucke's successor in the chair of surgery at the University Theodor Kocher, in 1874, published his first paper on the thyroid gland—on the pathology and treatment of goitre. In this paper he published his first thirteen goitre operations, with two deaths only. In this paper he said that there were three forms of operation for goitre: total thyroidectomy, partial thyroidectomy, and enucleation. He said that the total thyroidectomy was an easier procedure "than partial thyroidectomy, but it is a question whether there is any connexion between the total extirpation of the thyroid gland and the altered mental condition I have noticed in one of my cases of total thyroidectomy." His goitre operations were already at that time done on a preconceived plan—he sought in each case to ligate the arteries first. A few years later (1887) he published his first operations for malignant goitre, describing a method of "évidement" of soft malignant tumours, especially intrathoracic ones.

In 1883 he published the results of his first 101 goitre operations. He gave at the same time a list of all the goitre operations done down to 1883. He found that with his own 101 cases 240 goitre operations had been performed. In this same paper he detailed his exact method of operating, and then described the consequence of total thyroidectomy. He had reviewed all the cases he had operated on, and in the eighteen cases where total thyroidectomy had been done he found the typical picture of myxoedema. In April, 1883, he read a paper on the consequence of total thyroidectomy at the German Surgical Congress, calling the disease "cachexia thyreopriva."

From that moment he began to treat these cases of total thyroidectomy by making transplantation of pieces of thyroid gland or goitre in many different parts of the human body—skin, muscle, arteries, peritoneum, intestine, etc.—but the effect was only temporary. Later on he reviewed these cases as often as possible; he found that those in which a real total thyroidectomy had been performed died within seven years after the operation (no thyroid tissue could be found at the *post-mortem* examination), whilst those who lived longer had developed a new but small goitre, proving that total thyroidectomy had not been done.

In the years from 1880 to 1890 he studied the question of the etiology of goitre, examining thousands of school children all over the canton of Berne, and examining especially the water at the different places. In 1889 he published a map showing a close connexion between geological formation and the distribution of goitre. At that time, in a public lecture, he urged the Government to have the drinking water in the public schools boiled, or to add iodine to it, in order to prevent goitre. In 1889 he published the results of another 250 goitre operations. In this paper he described his exact procedure in the operation he named "enucleation resection," including the collar incision of the skin. This method of operation for goitre was that used by him in all his goitre operations without any modification; it became and remains to-day the classical method of operation all over the world for nodular goitres. In fact, nothing new has been added to this method of operation anywhere or by anyone in the following thirty-seven years—that is to say, until the present time. This method not only included the collar incision of the skin now universally used, but also gave the exact method of leaving all healthy thyroid tissue behind, and so to assure a sufficient function of the thyroid, to prevent myxoedema, to avoid any lesion of the recurrent nerve and of the parathyroid glands, which became known only later on. Even nowadays, when the bilateral operation of nodular goitre is recommended by many surgeons, Kocher's enucleation resection is done on both sides. Hotz calls it the bilateral Kocher operation.

In 1892 Theodor Kocher published his paper on the origin and prevention of cretinism, in which he described a case of congenital goitre with cretinism, and showed that cretinism was due to lack of thyroid function, and could be prevented by the same measures as those by which goitre can be prevented. This point of view was very much, and for a long time, opposed, but has nowadays become the general opinion.

In 1887, when showing a case of Graves's disease to his students to illustrate a clinical lecture, he demonstrated the hypervascularization of the thyroid gland, and suggested that the symptoms of the disease were due to hyperthyroidism. He was the first to perform a successful operation for goitre in a typical case of Graves's disease. In 1897 he published sixty-nine cases of Graves's disease operated upon, with only four deaths.

In 1895 he read a paper on the action of iodine on goitres. In that paper he suggested that the normal thyroid gland must contain iodine, as the action of desiccated thyroid gland on goitres was the same as that of iodine. Unfortunately, the professor of chemistry at the University of Berne who made the investigation could not find any iodine in the thyroid glands he examined. A year later Baumann in Freiburg published his article on the normal iodine content of the thyroid gland.

In 1895 Theodor Kocher had done 1,000 goitre operations; in 1901, 2,000; and in 1905, 3,000. At the time of his death in 1917 he had personally performed 6,000 goitre operations.

In 1907 he read the opening paper at the German Congress of Internists at Munich, on the pathology of the thyroid gland, and in 1906 gave the annual oration (on the same subject) before the Medical Society of London (BRITISH MEDICAL JOURNAL, 1906, vol. i, p. 1261). This work was the starting-point of modern endocrinology, and contained all what we know at present of the pathology of the thyroid gland. In fact, nothing important has been added to it since. In 1907 he published also an important paper on malignant goitre, describing the different forms in conjunction with Langhans.

In 1908 he described his methods of gland grafting, publishing seventy-nine cases of transplantation in myxoedema, mongolism, and hypothyroidism. He specially recommended to take the transplant from a gland of a case of exophthalmic goitre, thus proving by his successful cases that the gland in Graves's disease is hyperactive and not toxic. In the same year he published the exact analysis of the blood in 260 cases of Graves's disease, showing that the leucocyte formula displayed a typical change, and a few years later he also showed a typical blood change in myxoedema, pointing out that the number of the lymphocytes in the blood was connected with the functional change of the thyroid gland. This close connexion of the lymphocytes and lymphoid tissue to the secretion of the thyroid gland has been established histologically lately by Williamson.

In 1910 Theodor Kocher gave the classical picture of *Iodbasedov*, showing that the use of iodine can produce Graves's disease in certain forms of goitre, and drawing attention to the harm that can in consequence be done by the use of iodine in goitres. Though at present the Mayo school has shown that Lugol's solution can in certain cases of Graves's disease bring about an improvement and make the operation less dangerous, Kocher's observations and statements remain quite true. The exact role of iodine in the disease is, however, far from being explained.

In 1911 Theodor Kocher published the results of 1,200 operations on the thyroid gland in Graves's disease, with 80 per cent. complete cures. In that paper he showed how the disease can be diagnosed in an early stage, and advocated early operation. He described a new lid symptom which appears very early—namely, the contraction of the levator palpebrae superioris when the patient is made to look up and down quickly.

In 1909 he was awarded the Nobel prize for his research work, and especially for his discovery of the function of the thyroid gland. He then gave before the Academy of Medicine of Stockholm an address in which he drew a classical picture of the minor functional troubles of the thyroid gland—hypo- and hyper-thyroidism. These conditions have been described again since without any reference to Theodor Kocher's publication. In the same year he described a functional test for diagnosis of thyroid disease, which consists of an exact blood examination, specification of the leucocytes, and determination of the time of coagulation; thyroid substance is then administered to the patient, and the blood count and coagulation test are repeated, and change in a typical way, according to the function of the gland. The diagnosis of the minor functional troubles, however, as well as the functional method of diagnosis, have not become generally known or used, as being methods too difficult for the ordinary practitioner. Albert Kocher has used this method ever since, and uses it also for all the endocrine glands, with similar results. To this method is due his successes in endocrinologic treatment; he finds it much more exact and sure than the control of basal metabolism.

At the meeting of the Swiss Surgical Congress in 1917, a few months before his sudden death, Theodor Kocher reviewed all his goitre operations, from which it appeared that he had had at that time a mortality of 2 per mille in operations of ordinary goitre and of 2 per cent. in Graves's disease. At the same time he gave a summary of our knowledge of the etiology of goitre, recommending the prophylactic treatment.

It is worth while to recall all that has been done for the advance of our knowledge about the thyroid gland by Theodor Kocher, and, under his guidance, by his people. It is noteworthy that Theodor Kocher never made any fantastic statements, but only drew those conclusions he could really prove, giving entire credit to all that others have contributed to the question. Since his death very little sound work has been done on the subject, but very many theories have been advanced. It is sad to note that the credit Theodor Kocher deserves is not given to him by many authors of the present day.

I feel sure you wish me, as your chairman, to thank Dr. Albert Kocher for an historical contribution which carries the knowledge of his father's work beyond any records I have seen in the English language. Personally I share the filial sentiments expressed in the last paragraph: I know it to be true also in other branches of surgery; still, I am glad to be able to say that things are slowly mending. In my review of Crile's book on the *Thyroid Gland* (BRITISH MEDICAL JOURNAL, December 9th, 1922) it was said: "All will agree with Professor Crile when he states that we wish first of all to express our sense of the obligation of medicine to Theodor Kocher in Europe for the secure foundation laid by him for surgery of the thyroid gland." Again, in the *British Journal of Surgery* (1926, No. 51) G. Scott Williamson said that the term "thyrotoxicosis" (Kocher) is preferable to "forme fruste." I will add one further illustration of a waking conscience from the youngest and latest journal, *The Leech*, of the Welsh National School of Medicine, in which no fewer than nine pages (October, 1926) are devoted to thyrotoxicosis, and due appreciation is shown of the master's work.

Water Supply.

We learn from the letter which I have just read that Theodor Kocher showed himself a scientific seer as long ago as 1889, when he indicated at a popular lecture his view that the cause of goitre was in water, and urged "the Government to have the drinking water in the public schools boiled, or to add iodine to it, to prevent goitre." It is evident that the late battle-ground regarding the cult

of iodine and its appraisalment in surgical cleanliness has been shifted to the medical preventive side in relation to goitre among school children. The value of the letter will become apparent when I read an extract from a very notable contribution to the thyroid gland by Charles H. Mayo and Henry W. Plummer, published in 1926, and described in the preface by the chairman of the Beaumont Foundation Committee as the most authoritative pronouncement upon the subject ever given: "At the time of his (Kocher) death in 1917 approximately 5,000 cases of goiter had been operated on at his clinic. In 1917 the practical application of a method to prevent simple goiter was started in the public schools of Akron, Ohio, by Marine and Kimball." There is a reference to a somewhat similar plan in my review, already referred to, of Crile's book. I there recalled the fact that Kocher held goitre to be water-borne, due to "a hitherto unknown micro-organism, or more probably a chemical agent . . . made inoffensive by boiling the water. That is why he proposed, forty years ago, to boil all the drinking water, especially at the schools, to prevent goitre. But at the same time . . . he proposed to give the children twice or three times a year during some weeks a small dose of iodine to prevent goitre. He had then a malt preparation made with iodine and iron." This preparation he gave to his own three sons three times a year. "The result is that [the] three brothers have absolutely normal thyroid glands." (BRITISH MEDICAL JOURNAL, 1922, ii, 1123.) It is interesting to recall that in 1854 it became known that cholera was a water-borne disease, although the actual cause was not then discovered; we are to-day in a somewhat similar position with regard to goitre, but are very near the goal.

Incidence of Goitre in Wales.

I had hoped that the inquiry instituted by the Ministry of Health into the incidence of goitre in our country would have been ready before this, as it would have been of great interest, but unfortunately I heard from Sir George Newman, who has given me much help, that the memorandum on the subject had not yet been published. It is now over twenty years since the late Dr. Williams, M.O.H. Glamorgan, and I instituted an inquiry into the incidence of goitre, and received replies from 231 medical practitioners. In a paper read before the Medical Society of London on April 22nd, 1907, I reported that "as far as I can judge from analysis of the evidence collected, the distribution of goitres in Wales and Monmouthshire supports the view that the causation of this disease is to be found in drinking water."

Goitre is found in almost every country in the world from sea-level to 10,000 feet above, wherever soil exists for man to live on. In Wales it is fairly common in counties bordering the sea, and also in patches inland—for example, Gwendraeth valley, Llanidloes, Vale of Clwyd. It is found on soil which covers rocks a million, ten million, or a hundred million years old; the chemical composition of the geological formation is apparently of little importance—the surface soil is the only factor left that counts.

Goitre is fairly common over the ordovician rock in Cardiganshire, where, in cuttings or quarries, the mother rock may be covered with a crushed layer, called "rab" locally—evidence of the weight and direction of the enormous ice sheet that ground and rounded off the general contour of the land. There is often very little soil over the "rab"; the rock is notoriously deficient in lime salts, but goitre is not uncommon.

The Cause of Goitre—Micro-organism, Iodine Deficiency, or Endocrine Imbalance?

Evidence is accumulating so strongly, that one of Kocher's double-barrelled predictions of "the unknown organism" as the cause of goitre will, I think, shortly be fulfilled—for example, that from the Mayo Clinic: "Rosenow has isolated an anaerobic Gram-positive diplobacillus-like organism from the excised thyroid gland in twenty-five of thirty-two cases of goitre." "Of the sixty-eight animals infected with strains from sixteen patients (ten with exophthalmic goitre and six with non-toxic goitre) and examined soon after injection, thirty-four (50 per cent.) developed gross lesions in the thyroid."

The part iodine plays in the etiology of goitre I leave in the able hands of Colonel McCarrison, I.M.S., whose valuable work on the etiology of goitre is well known, and who has now in the press a report of his experience at the Lawrence Royal Military School, Sanawar, Punjab, India, which, in its precision, almost amounts to a scientific experiment. The work was commenced in 1913, and observations have been continued ever since. [The story is told in the paper by Colonel McCarrison published in this issue at page 94.]

Upon this aspect of the subject I have consulted Professor H. J. Fleure of the University College of Wales, Aberystwyth, whose knowledge, alike of the geology and anthropology of Wales, is unsurpassed. He writes:

"While we have made observations as conscientiously as possible on goitre, I cannot say that they have led to any very clear conclusions as to any one particular cause. We find that the administration of iodine has been undoubtedly valuable in a number of cases. It has been given in the form of iodized table salts. Whether the importance of this is the direct contribution of iodine to the system or whether the iodine acts as an enemy to some factor of the disease, we do not presume to say. Alongside of this we have found the insistence on boiled water very important, but whether this implies that the disease is connected with some filter-passing germ or of some chemical which is altered by boiling, we do not know. There is no doubt that, along with curative measures such as the above, it is very important to take measures to maintain and develop the resistance, and this is done in two ways. In the first place, therefore, attention should be given to the teeth, which for some reason which needs investigation are notoriously bad in West Wales. In the second place, Miss Fleming has urged the use of an improved vegetable and fruit diet, including fruit and fresh greenstuffs. The fruit is chiefly apples and oranges. We cannot but think that one of the problems involved is some question of a balance of endocrine secretions, and this is apparently very liable to be altered by inbreeding, so the troubles connected with this alteration of balance are specially abundant among the peoples of isolated districts."

Details in Operative Technique.

Before concluding my somewhat discursive remarks I venture to draw attention to the importance of carrying out some details in operative technique which facilitate work and give the best results in most operations on the neck and specially those for goitres.

The first is to follow the direction of Kocher's collar incision in all operations on the neck, whether small or large, and to avoid making a longitudinal incision; in this way a hazardous bloody operation is converted into a practically bloodless one without any risk of injury to nerves, for the surgeon sees every step before moving on.

The second is to place the patient in what I described in 1907 as the "Albert Kocher" position, which means a semi-recumbent or anti-Trendelenburg position, by which the superficial veins of the neck are converted into empty flat tubes during normal respiration.

The third is to remove sutures or clips and drainage tube within twenty-four hours after operation; this avoids all scarring beyond the inevitable thin white threadline left by the collar incision. It is perfectly safe to remove silk sutures—to which I am biased, by imitation of Kocher—but it is necessary to remove only an inch at a time, then secure apposition by fixing half-inch wide gauze strips with collodion crosswise to the collar incision. In order to avoid any possible risk of the buried subcutaneous portion of the silk suture, it is wise to paint the skin beforehand with iodine, then pull gently on the suture to enable the surgeon to cut the portion that was subcutaneous, thus avoiding withdrawal through the wound of the exposed portion of the silk suture, which is of the finest size for the smallest skin-needle.

Lastly, it is important in operations to mark the skin at right angles, in two or three places, before making the incision, according to its length, to serve as landmarks in restoring the skin and subcutaneous tissues to their normal disposition. I described the method in a paper read before the Medical Society of London in 1907, but as I did not explain how the idea originated, I do so now to illustrate how an idea sometimes starts from an accident. Of the 73 operations recorded, 55 were performed under local and 17 under general anaesthesia. In the remaining case no anaesthetic was employed owing to breaking of the hypodermic syringe, and I proceeded with the operation by transfixing the skin after the fashion of pre-anaesthetic days. After finishing suture of the skin with continuous

silk I discovered that a mole had been divided and that the sutured halves were at least half an inch apart. I removed the suture in order to restore the mole, which subsequently formed a landmark. I copied this hint and applied it in every operation afterwards; it is of some practical importance, more especially in the restoration of skin to the normal; the surgeon quickly realizes by marking the skin with the point of a needle (Moynihan) how almost impossible it is to get normal alignments without skin landmarks.

Arthur Keith, discussing the law of collateral or "uniform evolution" "as certainly valid for the order of animals to which man belongs," says he does not think it possible that the

"Mongolian stock had arisen from an anthropoid of the orang type, while the African negro had drawn his origin from the ancestral type of the gorilla... there are certainly superficial points in which the Mongolian type resembles the Bornean anthropoid... Cretins of all races are alike. They cease to be Europeans or Asiatics in appearance. Cretinism is the result of a defect of the thyroid gland:... so potent is this gland in fashioning the features that a cretinized English child might be taken, by a superficial observer, as brother to a Chinese cretin. It is also so, when the pituitary gland becomes disordered.... The glands of internal secretion are parts of the machinery of evolution, not only of man but of apes. The resemblances of the orang to the Mongolian type are due to thyroid dominance in the action of their glands of internal secretions." (*Antiquity of Man*.)

The youthful Dr. Rip Van Winkle who went up the Catskill Mountains in 1883 came down to-day to find strange things to convey his successor to consultations by road and by air; he read strange records of the value of x rays, radium, and cardio-electrography in Graves's disease; but the strangest thing of all was to listen to a wireless discourse from the wonder hospital which had grown in thirty years from a cottage hospital with a staff of three to that of a University Medical School with a staff of 301—the far-away Mayo Clinic—on the revelations in the physiology of the thyroid gland, and on revolution in the surgery of goitre, carefully engineered and successfully launched from Berne.

AN EXPERIMENT IN GOITRE PREVENTION.

BEING

THE FURTHER HISTORY OF GOITRE AT THE LAWRENCE ROYAL MILITARY SCHOOL, SANAWAR, PUNJAB, INDIA.

BY

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IN a report on the causation of goitre at the Lawrence Royal Military School, Sanawar, Punjab, Northern India, submitted to the Indian Research Fund Association in 1914¹ it was shown that the disease was not due to any chemical substance (lime, magnesium, etc.) in suspension or in solution in the water supply. The conclusions were drawn that goitre in Sanawar was due to the presence of living micro-organisms in the water supplied to the children for drinking purposes; and that the disease could be eradicated by the provision of a chemically and bacteriologically pure water.

Goitre had been endemic in Sanawar since the foundation of the school in 1848. So great was its prevalence that in some years as many as 50 per cent. of the children suffered from it; while after a residence of eight years in the school about 80 per cent. became goitrous. At the time my investigations were begun (1913) no less than 66 per cent. of girls above the age of 16 years were the subjects of noticeable goitres. Many of the swellings were slight and some of them transitory, but a high proportion were true goitres (not merely physiological swellings) which caused noticeable disfigurement. Full details regarding the incidence of the disease and the investigations which led to the above conclusions will be found in the report referred to.

Following the recommendations made in this report a new pipe water supply, from the neighbouring station of Kasauli² was provided in 1918. Thereafter goitre began

to diminish and has now disappeared. Captain P. Savage, I.M.S., the present medical officer of the school, in a letter to the principal, of which a copy was sent to me on January 30th, 1926, writes:

"One year's experience has convinced me that goitre is now entirely absent. I have not seen a single case, and I propose to mention in my annual report that goitre can now be considered a thing of the past."

Similar reports were received from previous medical officers. Thus one states, in a letter dated June 21st, 1921:

"There have been no fresh cases of goitre noted this year. The disappearance of goitre is probably due to the fact that the water supply was changed from the Sanawar spring to the Kasauli supply. This fact was intimated to the Inspector-General, Civil Hospitals, Punjab."

Again, on October 17th, 1921, the Assistant Director of Medical Services in India reported that "Since the Kasauli water supply has been piped to Sanawar there has been a complete absence of goitre."

In the autumn of 1923 I revisited the school, with the object of seeing for myself what was then the incidence of the disease. I found one boy, aged 16, who had still some enlargement of the thyroid, and ten girls, at or over the age of puberty, who were the subjects of small goitres, some barely noticeable. The remaining 489 children were free from goitre. The incidence of the disease was thus 2.2 per cent., or no greater than the incidence of thyroid enlargement among school children residing in non-endemic areas³ such as Delhi (2.2 per cent.), or Kasauli, from which the new water supply was derived (2.4 per cent.). It was no greater, also, than in another Lawrence Royal Military School in Southern India, at Lovedale in the Nilgiri Hills. This school is situated in a region where the iodine content of the soil is very high (300 to 400 parts per 10 millions); at a recent examination of 452 of the children I found ten cases of visible goitre, involving both lobes and the isthmus, in 162 girls; and one case among 290 boys. Of these eleven cases two were in girls who had acquired the swelling at the Sanawar school. It had not disappeared following their transfer to the Lovedale school. My experience has been that in any community of school children there will always be found a greater or smaller number of thyroid swellings which bear no relation whatever to endemic influences.

It is clear, then, that goitre, which had been endemic in Sanawar for seventy years, has now disappeared; and that its disappearance has been due to the introduction of a new and protected water supply. Its eradication within the short space of three years is, so far as I am aware, unparalleled in the history of goitre prophylaxis. Similar instances are to be found in the literature,² but none in which the endemic has been so carefully followed throughout its whole course nor in which the measures decided upon for its eradication have followed more exhaustive study of the local conditions.

The new water supply may have caused the disappearance of the disease either because it increased the iodine intake of the scholars or because it was a bacteriologically pure water, whereas the old supply was grossly contaminated.¹ I have the assurance of the principal, contained in his letter of May 9th, 1923, that "no changes of any importance were made in the diet between 1914 and 1922." There was, therefore, no increase in the iodine intake by way of the food. Consequently, the question to be decided was whether or not the new water supply contained more iodine than the old. The Chemical Examiner, Punjab, in his report on the new water supply, dated March 18th, 1922, stated that "The sample is of very good quality chemically and remarkably free from impurity. It contains only traces of lime and magnesium and no iodine." I then caused 25 gallons of the new supply, as delivered by pipe at Sanawar, to be evaporated to dryness after the addition of sodium carbonate. This was done under the supervision of the Director, Central Research Institute, Kasauli (Lieut.-Colonel S. R. Christophers, I.M.S.). The residue was sent to the Chemical Examiner, Punjab, for estimation of its iodine content. In his report, dated August 2nd, 1923, he stated that iodine was not detected in any form in the residue.