

T I T L E.

SOME CLINICAL ASPECTS of SIMPLE GOITRE

in CHILDREN with SPECIAL REFERENCE to the

CHALK VALLEYS of WILTS.

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INTRODUCTION.

Simple goitre occurs in most countries of the world and in certain areas it is endemic. These endemic areas are usually found in

- (1) Mountainous regions, e.g. the Himalayas, the Alps, the Pyrenees; and, in Great Britain, the Cotswolds, Pennines, and Mendips.
- (2) River beds, e.g. the region of the St. Lawrence and Great Lakes in America, the river valleys of New Zealand.

The area I propose to describe falls into the latter group.

Systematic investigations have been recently carried out in New Zealand,⁽¹⁾ but there have been few such investigations in Great Britain.

Work in this country has been mainly concerned with the treatment of goitre in school children with iodine. In Cumberland, Fraser⁽²⁾ found that excellent results followed iodine treatment. In Derbyshire, Ash⁽³⁾ found the results of treatment of goitre with iodine inconclusive. In Swindon, Brewer⁽⁴⁾ on the basis of five years' work, states that iodine is definitely curative. Turton,⁽⁵⁾ in Derbyshire says that iodine is definitely not curative, but/

- (1) Hercus, Benson and Carter (1925) Jour. Hygiene vol 24, p. 231. Hercus and Roberts (1927) Jour. Hygiene vol. 26, p. 49.
- (2) Fraser K. (1925) Report School M.O. Cumberland C.C. p.51.
- (3) Ash (1925) Report County M.O.H. Derby.
- (4) Brewer (1925) Report School M.O.H. Swindon.
- (5) Turton 1927 Prophylaxis and treatment of childhood Goitre. Lancet Dec. 3rd 1927 (p.1170).

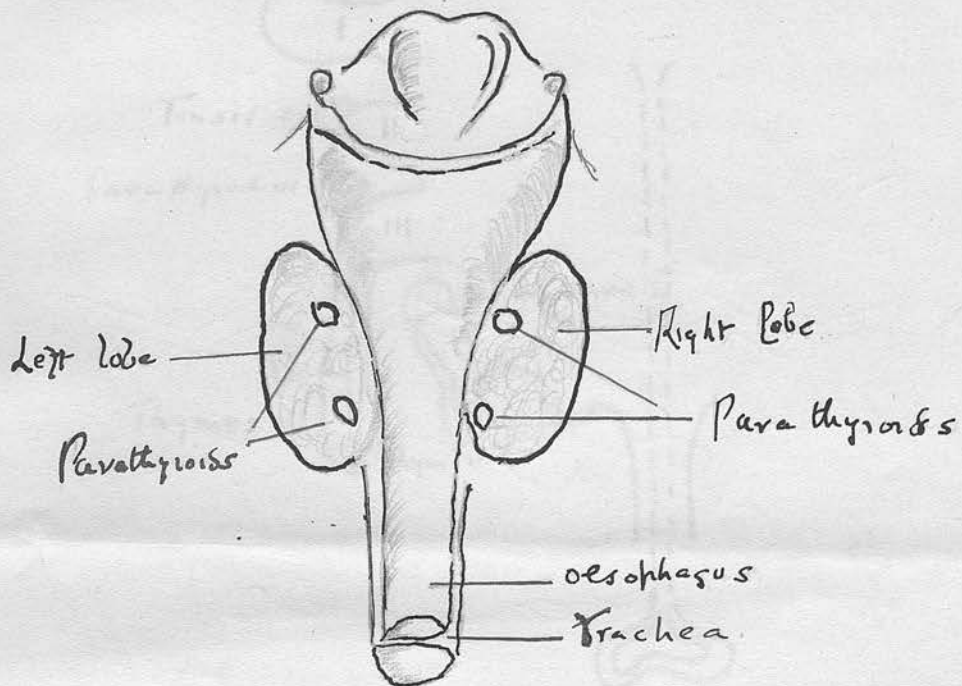
but in some cases appears to increase the size of the goitre. The period of observation in most of his cases is confined to six months, and in his age groups he fails to exclude those cases of thyroid enlargement at the puberty and pre-puberty stages.

Except in the case of the last writer, I have found in the literature no detailed description of localities where endemic goitre occurs.

In this country there is a patchy mode of occurrence of endemic goitre. A systematic study of goitre in these different districts, especially in relation to geological strata and water supply, would yield valuable results to public health, and materially help towards the solution of the etiology of the disease.

Goitre may not appear a serious disability in itself, but, occurring as it does in childhood, the whole defensive mechanism of the body against disease is lowered at a critical age; the child falls into a "dull and backward" category at school, and the result is that the subject is handicapped in later life both mentally and physically.

I have not come across in the extensive literature of goitre in this country, any clinical study of the goitrous child. As I have attempted to show below, there are certain features in the clinical condition of the child/



Human thyroid and parathyroids from dorsal aspect.
 (Halstead and Evans).

varying shape, but for the most part irregularly spheroidal/

spheroidal. The largest are 0.1 m.m. in diameter, but child that must be regarded as necessary accompanying factors in the production of goitre. is lined with

THYROID GLAND ANATOMY.

The thyroid gland is an endocrine organ, e.g. it forms some specific chemical substance within its cells and passes this into the blood-stream. The thyro-parathyroid group of endocrine glands consists of:-

- (1) The thyroid proper, a yellowish red organ with a fibrous capsule which generally takes the form of two lobes situated on either side of the larynx and windpipe, united by an isthmus over the trachea.
- (2) The parathyroids, generally two on each side lying in contact with the corresponding lobes of the thyroid on its dorsal aspect. (Fig. 1).

DEVELOPMENT.

The thyroid appears very early in the course of development, being nearly the first organ to become distinct in the human embryo. It is seen about three weeks as a hollow median thickening of the entoderm lining the floor of the pharynx at the level of the interval between the first and second branchial clefts. The ductus thyreoglossus has closed by the time the embryo is 6 m.m. in length. The original opening is marked throughout life by the foramen caecum. Developmentally it is to be noted that the tonsils and thyroid are closely related. (v. Fig. 2).

STRUCTURE.

The thyroid consists of small closed vesicles of varying shape, but for the most part irregularly spheroidal/

spheroidal. The largest are 0.1 m.m in diameter, but many are much smaller. Only in cases of endemic goitre are they much larger. Each vesicle is lined with epithelium, columnar, or flattened if the vesicle is distended. There is no definite basement membrane separating the epithelium from the connective tissue and blood vessels. The vesicles are generally filled with the so-called "colloid."

The thyroid is one of the most vascular organs in the body. The arteries (inferior thyroid from the subclavian through the thyroid axis, and superior thyroid from the external carotid) form anastomoses at the surface of the organ. The capillaries form a close network around each vesicle and come into immediate contact with the vesicular epithelium. There are numerous lymphatics within the organ, and large efferent vessels accompanying the veins convey away the lymph. The colloid contains the active principles of the secretion probably forming a store from which they can be extracted as required by the organism.

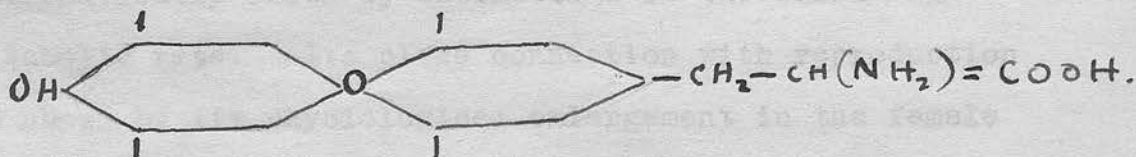
Like other outgrowths of the alimentary tract, it has both a sympathetic and a para-sympathetic nerve supply, the former, which carries the chief secretory impulses, being derived from the superior cervical ganglion, the latter from the superior and inferior laryngeal branches of/

of the vagus.

THE THYROID HORMONE.

In 1896 Baumann⁽¹⁾ isolated from the thyroid an organic iodine containing compound which he showed to have the physiological properties of the whole gland. The next step in our knowledge of the hormone is due to the work of Kendall on the chemical side and to that of Boothby on the physiological side. Kendall⁽²⁾ (1919) isolated in crystalline form a substance which was shown later by Boothby (1924)⁽³⁾ to have the main physiological properties of the thyroid.

More recently Harington (1926)⁽⁴⁾ having devised an improved method for the isolation of thyroxin, has assigned to it the empirical formula $C_{15}H_{11}O_4NI_4$ and the following structure.



Thyroxin is therefore a body of comparatively simple composition and molecular weight, containing four atoms of iodine attached to two linked benzene rings.

FUNCTIONS/

- (1) Baumann (1896) Ztschr. f. physiol. chem. v.21, p.319
- (2) Kendall (1919) Jour. Biol. Chem. v. 39, p. 125.
- (3) Boothby (1924) Physiol. Rev. v.4, p.69.
- (4) Harington (1926) Biochem. J. v.20, p.293.

FUNCTIONS of the THYROID GLAND.

- (1) It governs the growth of all cells, and sustains their functional activity.
- (2) It neutralises the action of toxic substances produced in the normal metabolism of tissues.
- (3) It assists the defensive action of the organism against bacterial toxins.

As McCarrison⁽¹⁾ puts it:- "The thyroid is to the human body what the draught is to the fire." It stimulates growth in the young, e.g. the athyroidic subject remains a dwarf. It assists in the destruction and elimination of the protein molecule throughout life. It diminishes the storage of sugar and promotes the dehydration of fat. It also lowers the threshold of response to sympathetic stimulation. In all these ways it is an active accelerator of metabolism as can now be mathematically shown by estimations of the basal metabolic rate. Its close connection with reproduction is shown by its physiological enlargement in the female at puberty and pregnancy. Thyroxin plays an important part in the re-action against bacterial infections.

ETIOLOGY. The problem of the etiology of goitre still remains obscure despite observations and theories by many investigators for over a century.

There/

(1) R. McCarrison "The Thyroid Gland."

(1) Derry - "Simple Goitre" Lancet 1901, 612, 1025.

(2) McCarrison "The Thyroid Gland" 1917.

(3) Hergatz, Hansky, and Carter. Jour. Hyg. 1911, 31, p. 201.

There are, in the main, three theories:-

1. The earth and water theory ascribes the origin of goitre to inorganic substances in the geological character of the soil, or in the water which derives these substances from the soil. This is a very old view and has found advocates up to the present time, e.g. in Berry.⁽¹⁾ Briefly goitre has been shown to be most frequent on calcium-rich formations, and absent from formations such as granite and basalt.

2. The toxic infective theory assumes the existence of an infective agent, or, at any rate, a specific intestinal flora, the toxic products of which exert their mischief in the thyroid gland. McCarrison⁽²⁾ advocates this theory, and explains the occurrence of goitre on calcium rich formations to be due to the porosity of the soil allowing of the passage of infective material into the water. He ascribes the cause to a water borne germ. Although such a germ has not yet been successfully isolated, McCarrison found that cases of endemic goitre improved when treated with a vaccine from organisms isolated from the bowel, as well as with pure cultures of B.coli.

Hercus, Benson, and Carter⁽³⁾ in their survey in New Zealand found no correlation between contaminated water supplies and endemic goitre. The Swiss/

(1) Berry - "Simple Goitre" Lancet Feb. 6th 1926.

(2) McCarrison "The Thyroid Gland" 1917.

(3) Hercus, Benson, and Carter. Jour. Hyg. vol 24, p.321.

Swiss Goitre Commission in 1924 came to the same conclusion. Hence the factors producing goitre in India as found by McCarrison cannot be regarded as universal.

3. IODINE DEFICIENCY THEORY.

This theory, the revival of an old view put forward in 1850 by Chatin,⁽¹⁾ a Professor of Pharmacy in Paris, has had considerable prominence of late. A review of the existing information on the subject is to be found in the recent work of Orr and Leitch.⁽²⁾ The prophylaxis of goitre with iodine was carried out extensively in endemic areas in France during last century. In 1895 Baumann⁽³⁾ discovered iodine in the thyroid and found that the percentage of iodine in goitrous glands was considerably reduced. In 1922, a vigorous campaign was carried out by Eggenbergen⁽⁴⁾ and others in the goitrous district of Appenzell. By the use of iodised salt, in three years it was reported that no more cretins were born and congenital goitre had practically disappeared. Marine⁽⁵⁾, in America, confirmed Baumann's theory that goitrous glands contain less iodine than normal. Hercus, Benson, and Carter in 1925, in New Zealand found that the incidence of goitre could be co-related with the deficiency of iodine in food and water, and that prophylactic/

(1) Chatin, Compt. rend. Acad. d. Sci. v.31, p.280.

(2) J. B.Orr, & I. Leitch "Iodine in Nutrition" 1929.

(3) Baumann (1896) Ztschr. f. physiol. Chem.

(4) J.B.Orr and I. Leitch "Iodine in Nutrition" 1929, p.8.

(5) Marine (1915) J. Biol. Chem. v.22, p, 547.

(6) Hercus, Benson, and Carter - Journal Hygiene v.24, p.321.

prophylactic treatment of school children by the administration of potassium iodide in milk was successful.

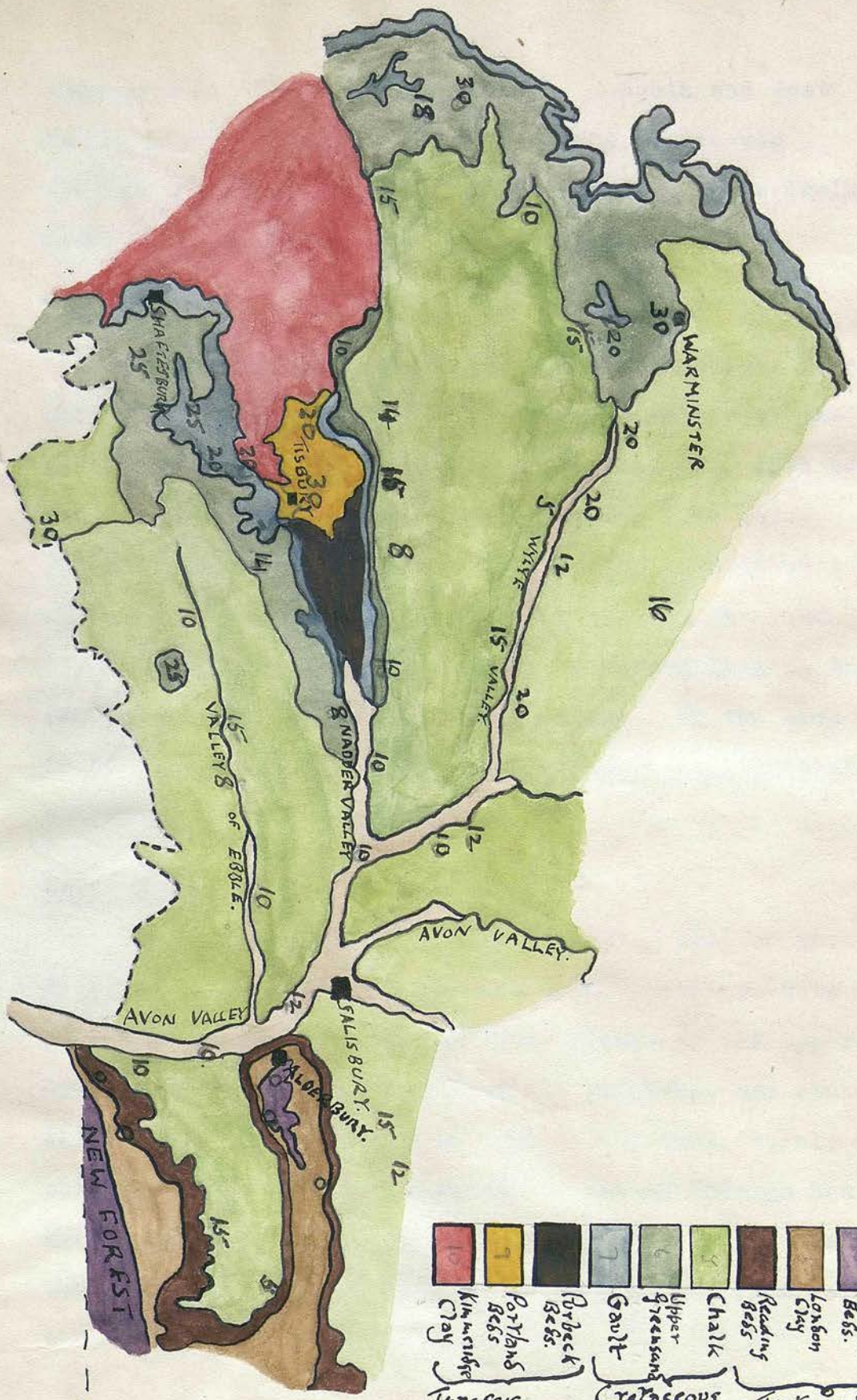
The work on the prophylaxis of goitre in this country is referred to in my introduction.

TOPOGRAPHY of SOUTH and WEST WILTS.

The investigation into endemic goitre was carried out in this district. It has an area of 180 square miles and a population of approximately 6,000 elementary school children, (exclusive of the City of Salisbury). Most of the district is occupied by undulating Chalk Downs which rise in some places to 700 feet. The Downs are deeply entrenched by river valleys, all tributaries of the Avon. The confluence is situated in the neighbourhood of Salisbury, which has been called the "Venice of England." Here there is a broad alluvial tract of several square miles. The population is mainly confined to four valleys, but there are a considerable number of villages and cottages scattered over the downs. One of the valleys, that of the Nadder, lays bare a few square miles of older cretaceous and Jurassic rocks in the Vale of Wardour. These older strata give rise to a scenery of a totally different character, with clay flats and outcrops of limestone, making bold scarps and flat topped hills very unlike the rounded chalky downs. Another area of distinct character is found in the south-east corner of Wilts. This is formed by the tertiary syncline near Alderbury (the scene of the labours of Tom Pinch in "Martin Chuzzlewit") and embraces part of the New Forest. Sandy heaths and well wooded land are here, extending/

GEOLOGICAL MAP OF SOUTH & WEST WILTS

Showing percentages of gorges children on the different geological formations.



1	2	3	4	5	6	7	8	9	10
Dinurian	Bagshot Beds.	London Clay	Reading Beds	Chalk	Upper greensand	Gault	Porbeck Beds.	Portlands Beds	Kimwidge Clay
Tertiary Beds.			Cretaceous				Jurassic		

SCALE OF FOUR MILES TO ONE INCH.

springs in the Greensand. In the Salisbury Rural District, the villages situated on the tertiary beds have a much poorer water supply, mainly from shallow wells in the gravel and chalk. The water found in the valley gravel is largely derived from the adjoining river or from the chalk. This source of supply is not a very safe one, for the gravel is very porous and the gravel flats are largely occupied by buildings and farms. Parishes along the river have frequently shallow wells in gravel, particularly noticeable in the Downton District.

Further reference is made to this subject in connection with the prevalence of goitre.

TYPE OF GOITRE.

In simple goitre endemic to this area the enlargement of the gland consists primarily in a distension of the organ with colloid, with resulting atrophy of the epithelial elements. Simple goitre is therefore not a hypertrophy of the gland. It is essentially a degeneration. If the cause that produced the increase in colloid be removed, the gland quickly returns to normal. If the cause persists, in two years or more a fibrosis due to slight chronic inflammation sets in and the condition gradually becomes a permanent one. This interstitial fibrosis is frequently followed by calcification. The retention of colloid leads to the formation of small cysts/

cysts which may coalesce into large ones.

This degeneration of the thyroid in simple goitre is almost invariably accompanied by symptoms of hypothyroidism. Nevertheless, I have encountered in my investigation 2 cases in school children with goitre who showed signs and symptoms of hyperthyroidism. Their clinical history is given later. (p.26). Schafer⁽¹⁾ has noted the existence of such exceptions occurring in the early stages of simple endemic goitre. In my cases hyperthyroidism developed in the fourth year of simple goitre.

In my series of cases I found that the thyroid usually showed signs of enlargement between the years of 7 and 9. The enlargement was diffuse, soft, and uniform, the outline of the thyroid being of horse-shoe shape. Within a year or so the swelling became firmer and asymmetrical, and usually the right lobe was the larger. Two years or so later small cysts or adenomata could be seen or palpated in the substance of the gland. This enlargement was accompanied by symptoms of hypothyroidism. Goitre was frequently noted in the children of goitrous parents. The goitre usually appeared at an earlier age in these cases. Goitre does not appear to be inherited, but, where the parent is goitrous, it usually/

(1) Schafer - The Endocrine Organs. Vol. 1, p.39.

usually follows that the children, brought up as they are in the same environment and under the same conditions, also show signs of goitre. Goitrous parents with healthy children have also been frequently noted, and also cases in which some of the family are affected and others not.

I have adopted the following standards in classifying goitrous children:-

Class I. (in tables indicated with one +).

Children in whom the thyroid was little felt on palpation, but sufficiently enlarged for the increase in the size of the neck to be noticed on casual inspection.

Class II. (indicated as ++).

Children in whom the thyroid was easily felt and the outline of the neck obviously enlarged.

Class III. (indicated as +++).

Children in whom the shape of the neck was sufficiently altered to be called a goitre.

All children reported on are 12 years of age and under. I have thus ruled out the pre-puberty period as a factor in thyroid enlargement. This period has been included by some writers⁽¹⁾ in their investigations, and has confused the picture.

In my first 300 cases I found 148 boys to 152 girls affected. In later life the ratio, according to the literature, is 6 females to 1 male, but this is explained by/

(1) Turton:- Prophylaxis and Treatment of Childhood Goitre - Lancet Dec. 3rd 1927.

by the greater strain on the thyroid in females at the critical periods of puberty, marriage, and pregnancy.

GEOLOGICAL MAP of SOUTH and WEST WILTS showing percentages of goitrous children found on the different geological formations. (p. 10.a).

From the above map it is evident that goitre incidence varies on different geological formations. Thus:-

- (1) Tertiary Beds show no goitre incidence.
- (2) Alluvial deposits of river beds show 10% - 15%.
- (3) Chalk shows 15% - 20%.
- (4) Upper Greensand and Gault (cretaceous) show 20%-30%.
- (5) Purbeck and Portland Beds (non-cretaceous) show 20% - 30%.

Goitre incidence is therefore not confined to cretaceous soils, Purbeck and Portland Beds being Jurassic and a lower geological formation than chalk.

It should, however, be noted that these Jurassic formations are never more than two or three miles distant from the chalk.

It is evident, also, that goitre incidence increases with the height above sea level - tertiary beds and river valleys being 100 - 200 feet above sea-level, and cretaceous and Jurassic formations being 300 - 700 feet above sea level.

WATER SUPPLY.

(1) The villages situated on the tertiary beds have as their main source of water supply shallow wells in the gravel/

gravel, or in the gravel and upper chalk. The water supply on the tertiary beds is poor in comparison with other areas; many shallow wells are in use which have often been found contaminated as many houses are clustered together there without any water carriage sewage scheme. Goitre incidence is practically nil in this area.

(2) Villages on the chalk have, as their main source of water supply, wells in the chalk. These wells have occasionally been found to be contaminated after heavy rains but not to the same extent as wells in the tertiary beds. Here the incidence of goitre is 15%-20%.

(3) Villages on the Upper Greensand, Gault, Portland and Purbeck beds are supplied by springs from the upper Greensand. This supply is excellent and safe. The urban districts of Tisbury and Warminster have both excellent piped gravitation water supplies from springs in the upper Greensand, and these two districts show the highest incidence of goitre in this area.

It is interesting to note that one of the ~~few~~ goitre-free families in the former district was found to be using, and to have used for years, a private surface well which from its position could not fail to be grossly contaminated. This family was also one of the very few who did not use the district supply.

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There is, therefore, no evidence in this area of Wiltshire that contaminated water is a factor in the causation of goitre. There is, however, evidence that all waters in this goitrous area contain mineral matter of a calcareous nature in suspension.

A typical sample of water from a greensand spring shows the following solid constituents:-

<u>In parts per 100,000.</u>	<u>Probable combinations.</u>
Ca. 5.5	Calcium Carbonate 11.6
Mg. .07	Calcium Sulphate 3.05
Na. 1.45	Magnesium Sulphate .3
CO ₃ 7.0	Sodium Chloride 2.8
SO ₄ 2.4	Sodium Nitrate 1.23
Cl. 1.7	Silica etc. 1
NO ₃ .9	

Total Solid Constituents dried at 180°C. 19.98

Hardness, temporary 10°
 permanent 5°
 Total 15°

...the thyroid is enlarged...
 ...the child is distinctly backward at school, and often brought forward by the teacher for entertainment as to whether the child is really-minded. The child is difficult in its school environment. The face is dull, heavy, and stupid. The child is subject to bronchial asthma, sore throats, and dry patches of the skin.

1913

CLINICAL TYPE.

It is proposed now to give a short clinical description of the typical goitrous child as found in this area.

The parents are agricultural workers, or the father is a shepherd on the downs - weekly wages 30/- - 40/- a week. The child comes of a large family. On casual inspection it is noted that the child is distinctly malnourished and under-weight for its age of 8 years. The body is ^{often} flea-bitten and the child is inefficiently clad. The skin is dry, and there are patches of dry desquamating skin on the face (locally known as "scrive.") The thyroid is easily seen and easily felt. Sometimes small adenomata are felt in the substance of the gland. The tonsils are enlarged, unhealthy, and there is often chronic tonsillitis. The tonsillar glands are freely palpated. There is often nasal catarrh. Xerophthalmia is noted. The child is distinctly backward at school, and often brought forward by the teacher for ascertainment as to whether the child is feeble-minded. The child is difficult in its school environment. The face is dull, heavy, and stupid. The child is subject to bronchial catarrh, sore throats, and dry eczema of the skin.

DIET/

DIET.

I found that tea, bread, margarine, and jam with perhaps a small quantity of milk was the usual diet of these children. Tinned fruit and tinned meat occasionally supplemented the diet, and a cooked joint on Sunday for the family was the rule. Strangely enough in a rural district, vegetables were not considered a necessary adjunct to the diet. If hens were kept, the eggs were sent into market. The diet was thus lacking in vitamins, fats, animal protein and iodine containing foods.

I append a table of 100 cases of goitre, all of which I have had under close observation as to their clinical condition and mental development for 2 years.

Table - showing 100 cases of GOITRE in School-Children, with associated defects, and a

note of the INTELLIGENCE QUOTIENT in each case.

Initials.	Sex.	Age.	District.	Degree of Goitre.	State of Nutrition.	State of Tonsils & Glands.	Intelligence Quotient.	Other associated defects, and notes.
B.A.	F.	7	Amesbury.	++	Subnormal.	Enlarged tonsils.	90.	
T.H.	M.	11	Barford.	+	Malnutrition.	Chronic tonsillitis.	80.	Anaemia.
P.S.	M.	9	Barford.	+	Malnutrition.	Tonsils removed.	80.	Asthma.
K.H.	F.	10	Barford.	+	Malnutrition.	Unhealthy.	90.	
V.A.	F.	10	Britford.	+	Malnutrition.	Chronic tonsillitis.	80.	Flea-bitten. Anaemia.
L.I.	M.	11	Britford.	+	Subnormal.	Enlarged.	75.	Rheumatic infection.
R.A.	F.	9	Berwick St. John.	+	Subnormal.	Chronic tonsillitis for 3 years.	95.	
M.W.	F.	12	Berwick St. John.	+	Malnutrition.	Enlarged.	90.	Anaemia.
G.C.	F.	10	Berwick St. John.	+	Malnutrition.	Enlarged.	90.	Flea-bitten.
I.O.	F.	9	Bishopstone.	+	Subnormal.	Enlarged.	95.	
B.P.	F.	6	Bowerchalke.	+	Malnutrition.	Chronic tonsillitis.	65.	Associated stigmata. Congenital Syphilis. Dwarfed
B.G.	F.	11	Bowerchalke.	+	Malnutrition.	Tonsillar glands.	82.	Tuberculosis of Tibia.
J.P.	M.	10	Bowerchalke.	+	Malnutrition.	Tonsillar glands.	80.	
D.G.	F.	9	Bowerchalke.	+++	Subnormal.	Enlarged.	80.	Had Goitre at 5 years.
E.D.	M.	12	Bowerchalke.	+	Malnutrition.	Chronic tonsillitis.	80.	

Initials.	Sex.	Age.	District.	Degree of Goitre.	State of Nutrition.	State of Tonsils & Glands.	Intelligence Quotient.	Other associated defects, and notes.
C.M.	F.	12	Wardour.	+	Malnutrition.	Healthy.	80.	
L.A.	M.	8	Wardour.	+	Malnutrition.	Tonsillectomy.	100.	
J.H.	M.	5	Warminster.	+	Malnutrition.	Slightly enlarged.	95.	Bronchitis.
B.B.	M.	7	Warminster.	+	Subnormal.	Enlarged.	70.	
G.B.	F.	7	Warminster.	+	Malnutrition.	Marked enlargement.	85.	Uncared-for.
M.N.	F.	8	Warminster.	+	Subnormal.	Enlarged.	80.	Ichthyosis.
R.S.	M.	7	Warminster.	+	Normal.	Adenoids.	90.	
J.H.	F.	10	Warminster.	++	Subnormal.	Enlarged.	95.	
G.B.	F.	10	Warminster.	+	Malnutrition.	Healthy.	90.	Bronchitis.
J.J.	M.	10	Warminster.	+	Subnormal.	Enlarged.	90.	Eczema of face.
W.H.C.	M.	12	Warminster.	+	Malnutrition.	Unhealthy.	85.	Pre-tubercular.
B.B.	F.	10	Warminster.	++	Malnutrition.	Markedly enlarged.	70.	Undersized: feeble-minded.
N.J.C.	M.	11	Warminster.	+	Malnutrition.	Chronic tonsillitis.	90.	Eczema.
J.S.	M.	10	Warminster.	+	Malnutrition.	Nasal catarrh.	80.	Very dry skin.
R.H.	M.	12	Warminster.	++	Subnormal.	Tonsillectomy.	80.	
E.S.	F.	10	Warminster.	+	Malnutrition.	Enlarged.	75.	

OBSERVATIONS on NUTRITION.

From the foregoing table of 100 cases of goitre in children there are the following percentages of degrees of nutrition:-

Malnutrition.....53%
Subnormal Nutrition...28%

19% only of the children showed normal nutrition.

In describing the typical goitrous child, I have made notes of the usual dietary in those cases. This diet was lacking particularly in Vitamins A, B, and C, fats, animal protein and the iodine containing food-stuffs - milk, eggs, and fish which was not available owing to transport difficulties. The lack of vitamins in the diet was reflected in goitrous children in the presence of xerophthalmia, blepharitis, dental caries, and tendency to skin affection. In two schools in which a glass of milk was supplied privately at the mid-day interval, there was a noticeably small incidence of goitre - in marked contrast to the neighbouring schools which were otherwise under the same conditions.

It is therefore obvious that this afore-mentioned deficient diet and the resulting state of nutrition preceded the appearance of goitre and associated defects by many years. Goitre is not commonly found in the well nourished child. If, therefore, proper attention/

attention were paid to the child's diet and nutrition in the pre-school period, it seems probable that goitre during school life would be comparatively rare. Here lies the key to the prevention of goitre.

Adequate provision has been made by local authorities for the supervision and treatment of the child up to the age of one and during the school period. The gap between the ages of one and five is serious. If only the nutrition and proper feeding of the child during these critical years could be supervised, the results would be far reaching. There is here a big field of operation, with unlimited opportunity, for the health visitor.

OBSERVATIONS on TONSILS.

From the above table of goitre and associated defects it will be noted that no less than 62% of cases showed unhealthy tonsils and adenoids, either at the time of examination or at a previous date. A further 20% showed enlarged tonsils.

I found that goitre in children is heralded by enlarged tonsils. This may be an attempt on the part of the tonsils to supply the missing secretion. The tonsils later pass into a state of chronic tonsillitis and the tonsillar glands enlarge. Concurrently with these progressive signs of sepsis the thyroid begins to undergo a diffuse/

diffuse enlargement. If the diseased tonsils are removed at this stage (as often happens as the child suffers from sore throats and enlarged tonsillar glands) the thyroid continues to enlarge. After a year or two small adenomata may develop in its substance.

The case of two twin brothers which came under my notice is illustrative:-

A. - aged 16. Large asymmetrical goitre with small adenomata. Small goitre was noticed at age of 10. Tonsils were then unhealthy and were removed.

B. - (twin). No goitre; tonsils healthy. Slight goitre was noted at 10 years of age. Had general treatment.

A. is a class behind B. at school.

One would expect, from the frequency of diseased tonsils in the goitrous child, that there is also a liability to infectious and other diseases. Such is the case. Goitrous children were more liable to rheumatic infection, scarlet fever, and diphtheria, than the normal child. Tuberculous cervical glands and tuberculous bone disease were also common.

It is worthy of note here that 4 out of 5 cases of adolescent pulmonary tuberculosis, which came under my care, gave histories of goitre before the pre-puberty period and confessed to having only progressed to the fifth standard at school. (See p.24). Two other cases/

cases of pulmonary tuberculosis had part of the thyroid removed for large adenomatous goitres.

This is in accordance with the theory that thyroxin functions in the defensive mechanism of the body against bacterial disease, and a degenerated thyroid fails in this function.

OBSERVATIONS on MENTAL DEFICIENCY.

In the above table the intelligence quotient is recorded opposite each case. In the measurement of the intelligence use was made of the Stanford Revision and Extension of the Binet-Simon Intelligence Scale, with suitable alterations for rural children who were out of touch with populous areas. The Intelligence Quotient is calculated thus:-

$$\frac{\text{Mental age}}{\text{Actual age}} \times 100.$$

When a subject aged 10 only answers the tests required of a 7-year old, his mental age is 7 years and the intelligence quotient

$$\left(\frac{7}{10} \times 100\right) = 70.$$

I took as my standard that an I.Q. of 90 or over was within normal limits of intelligence, and an I.Q. of 70 or under was feeble-minded. Cases between 70 and 90 were considered "dull and backward." My estimate/

estimate of the I.Q. was always checked with the teacher's estimate of the child's capabilities. Thus a feeble-minded child of 10 was at the same stage as the 7-year olds in school, and could not be expected to progress beyond Standard IV. i.e. a 10-year's mental level. Temperamental defects were also taken into account, such as lack of amenability to discipline, lack of ordinary prudence, obstinacy, peculiar behaviour, thieving, and any abnormal habits.

In several schools I asked the teacher to bring forward her dull and backward children, and found from 60% - 65% of these children had goitre in varying degrees. Goitrous children were generally found to be dull, slow, and apathetic, being specially retarded in subjects requiring quick calculation, such as mental arithmetic. In reading, writing, and composition, the retardation was not so marked.

From the above table of 100 cases, 10 fall into the category of feeble-mindedness, (one case showing the stigmata of congenital syphilis as well as goitre is not included); 55 are dull and backward, and the remaining 34 are within normal limits of intelligence.

I therefore conclude that in a goitrous child there is usually a greater degree of mental dulness present than can be explained by the child's physical defects/

defects; that the earlier the age and the longer the persistence of the goitre, the greater degree there is of mental dulness. An observer, writing of a certain goitrous area remarks that "their necks may be thicker but their heads are not," yet it appears to me that, in this area at any rate, although there are many children with goitre of normal intelligence, there are more who show signs of mental dulness.

Thus a continued degeneration of the thyroid at a critical age leads to mental as well as to physical defect.

That the severity of goitre in this district is slight is evident from the fact that no cretins were discovered. Under the mental deficiency acts, I saw all children showing signs of mental defect whether attending school or not. I found several children who were considered cretins, and who were receiving treatment as such, but on further investigation these were classified as mongols.

TENDENCY of NEW-COMERS to the DISTRICT to DEVELOP GOITRE.

There is considerable local migration among the poorer class of agricultural labourer within the district, but little migration into the district from without.

I have, however, records of three cases of school children/

children from London who came to reside in an area where there was 20% of goitrous children.

- (1) V.G. (girl) aged 7; had tonsils removed before arrival; developed goitre within one year of residence.
- (2) R.N. (boy) age 10; boarded out from Dr. Barnardo's homes; developed large goitre within 9 months of residence.
- (3) A.C. (boy) age 11; boarded out from London; developed goitre within one year of residence.

HYPERTHYROIDISM.

In only 2 cases were symptoms of hyperthyroidism noted. ~~None~~ ^{Neither} of these had received iodine treatment. These cases were in girls over 12 years of age. Their clinical history is recorded below:-

- (1) L.G. At age of 7 - 9 years, chronic tonsillitis was noted. At age of 9 years, goitre developed and went on to irregular enlargement, especially of the right lobe. At age of 13, the case showed the following:-
 1. large goitre.
 2. tachycardia.
 3. exophthalmos and Von Graefe's sign.
 4. fine tremors of the outstretched fingers.
 5. chronic tonsillitis.
- (2) P.Y. At age 9, goitre developed, and chronic tonsillitis was noted. At age 13, the case showed the following:-
 1. goitre irregularly enlarged.
 2. tachycardia.
 3. exophthalmos with Von Graefe's and Joffroy's signs.
 4. fine tremors of outstretched hands.
 5. chronic tonsillitis.

Among adults, few cases of Graves' disease are encountered, judging from the records of the infirmary and outpatient/

out-patient department supplying this area. Deaths from exophthalmic goitre among adults were of very rare occurrence in the Registrar's returns for the area. This is not in accordance with the findings of Campbell⁽¹⁾ in similar areas.

I have recently had an opportunity of investigating the incidence of goitre in a mountainous region. The Highlands of Scotland have on several occasions been quoted⁽²⁾ as an example of a mountainous region free from goitre. This I have found to be incorrect. On the slopes of the hills surrounding Loch Tay in Perthshire, in one village community, I found 20% of the school children goitrous. The water supply from the hillside, coming from an uninhabited tract of land, did not give any indication of contamination, and the analyst's report, which is attached, confirmed this. There are plentiful outcrops of limestone on the hillsides and this shows similarity with geological formations and water supply in Wilts. The only other similarity is that the water filters through from sheep pasture land. It would be interesting to know if this is common to other goitrous areas.

It/ (contd. on p. 29).

- (1) Campbell (1927) Journal Hygiene. Vol 26, p.1.
(2) Sir James Berry - Simple Goitre; Lancet. Feb 6, 1926.
McCarrison Milroy Lectures. Jan. 1913.

Laboratory of City Analyst,
140 Perth Road,
DUNDEE, 27th June, 1930.

Result of Chemical Examination of a sample of water received on 26th June, 1930, from Robert McNicoll taken from Acharn, Loch Tay Side, Kenmore, on 24th June, 1930, by Dr. M'Iver.

Description of surroundings of Water Supply, and probabilities of Contamination:-

No obvious source of contamination.

Spring water.

One million parts of this water yield:-

Free Ammonia.....	.006
Albuminoid Ammonia032
Carbonate of Lime, etc.....	40.00
Chlorine.....	9.00
Nitrogen, as Nitrates.....	none
Nitrites	none
Hardness, in Clark's Degrees	2 ⁵ / ₄ ⁰
Lead or other poisonous Metals	none

REMARKS:-

This water has little colour (Yellow .6 Blue .2 Lovibond's Standard Scale) and contains an average amount of suspended matter. The yields of Free and Albuminoid Ammonias are low indicating organic purity. Saline material is low leaving the water soft and suitable for washing purposes. Nitrates are absent indicating freedom from "Previous Sewage Contamination."

On incubation of the water at blood heat there was only a slight odour. A Sedgwick Rafter Plankton did not reveal anything of note.

The analysis shows this water is of good quality and therefore fit for general domestic use.

(Sgd). Andrew Dargie. B.Sc. A.I.C.
County Analyst for Perthshire.

RECORD OF 50 CASES OF GOITRE treated with IODINE, or

with IODINE and EXTRA NOURISHMENT.

Initial. Age. in years.	Duration of Goitre	Notes on Case before treatment.	Number of courses of treatment with Iodine.	Result.
M.M.	12	Goitre ++; enlargement irregular. Chronic tonsillitis. Malnutrition.	^x 4.	Goitre unchanged. Tonsils healthy.
C.E.	10	Goitre ++; right lobe enlarged. Tonsillectomy at 7 years of age.	6.	No improvement.
E.E.	12	Goitre ++; right lobe enlarged. Tonsillectomy at 8 years of age.	6.	Goitre unchanged.
N.H.	12	Goitre ++; right lobe especially.	6.	Goitre unchanged.
E.D.	10	Goitre ++; cystic. Dwarfed. No other cretinoid signs except feeble-mindedness. Malnutrition.	^x 4.	Goitre unchanged.
A.M.	11	Goitre ++; cystic. Chronic tonsillitis. Malnutrition.	^x 2.	Goitre unchanged. Tonsils healthy.
C.S.	11	Goitre ++; cystic.	2.	Goitre unchanged.
F.B.	12	Goitre ++; irregular enlargement with adenomata. Malnutrition.	^x 4.	Goitre unchanged.
K.H.	12	Goitre ++; irregular enlargement.	4.	Goitre unchanged.
J.M.	12	Goitre ++; adenomata. Ichthyosis of skin.	^x 6.	Goitre unchanged. Skin much improved.
F.T.	12	Goitre ++; irregular enlargement.	2.	Goitre unchanged.

E.T./

x Indicates that Cod Liver Oil or extra milk was provided.

Initial Age, in years.	Duration of Goitre	Notes on Case before treatment.	Number of courses of treatment with Iodine.	Result.
E.T.	5	Goitre ++; irregular enlargement. Chronic tonsillitis. Dry skin. Malnutrition.	2 \bar{x}	Goitre unchanged. Tonsils healthy. Skin normal.
S.R.	5	Goitre ++; Chronic tonsillitis. Malnutrition.	2 \bar{x}	No diminution in goitre. Tonsils healthy. Nutrition improved.
N.S.	4	Goitre ++; irregular enlargement. Chronic tonsillitis.	4.	Goitre unchanged. Tonsils healthy.
R.D.	4	Goitre +++; chronic tonsillitis. Malnutrition.	2 \bar{x}	Goitre unchanged. Tonsils healthy. Nutrition improved.
F.W.	3	Goitre +++; adenomata. Malnutrition.	4 \bar{x}	No change in goitre. Nutrition improved.
D.P.	4	Goitre ++; irregular enlargement. Dry skin.	4 \bar{x}	Goitre unchanged. Skin improved.
F.W.	4	Goitre ++; irregular enlargement.	3.	Goitre unchanged.
B.D.	3	Goitre ++; malnutrition.	2 \bar{x}	1 $\frac{1}{2}$ " decrease in goitre.
S.M.	3	Goitre ++.	2.	1" decrease in goitre.
L.M.B.	3	Goitre ++; nasal catarrh. Malnutrition.	1 \bar{x}	1" decrease. No nasal catarrh.
D.G.	4	Goitre ++. Malnutrition.	1 \bar{x}	1" decrease.
K.S.	5	Goitre ++. Chronic tonsillitis.	4.	1" decrease. Tonsils healthy.
E.R.	4	Goitre ++. Chronic tonsillitis.	6.	1 $\frac{1}{2}$ " decrease. Tonsils healthy.
A.A.	2	Goitre ++.	2.	1" decrease.
V.B/				

x Indicates that Cod Liver Oil or extra milk was provided.

Initial. Age. in years.	Duration of Goitre in years.	Notes on Case before treatment.	Number of courses of treatment with Iodine.	Result.
V.B.	10	Goitre ++. Dry skin. Malnutrition.	1. ^x	1" decrease. Skin normal.
D.K.	8	Goitre +.	1.	Hardly visible.
J.L.B.	7	Goitre ++. Malnutrition.	2. ^x	Disappearance of goitre. Nutrition normal.
V.K.	10	Goitre ++. Chronic tonsillitis. Malnutrition.	2. ^x	Disappearance of goitre. Tonsils healthy. Nutrition improved.
A.H.	7	Goitre ++. Chronic tonsillitis. Dry skin.	2. ^x	Disappearance of goitre. Tonsils healthy. Skin normal.
L.E.	11	Goitre ++. Chronic tonsillitis.	3.	Disappearance of goitre. Tonsils healthy.
R.E.	8	Goitre +. Enlarged tonsils. Malnutrition.	2. ^x	Disappearance of goitre. Tonsils normal.
E.G.	9	Goitre +. Enlarged tonsils. Malnutrition.	3. ^x	Disappearance of goitre. Throat healthy. Nutrition improved.
L.K.	10	Goitre +.	2.	Disappearance of goitre.
H.G.	8	Goitre ++. Chronic tonsillitis.	2.	Disappearance of goitre. Tonsils healthy.
M.F.	11	Goitre +.	2.	Disappearance of goitre.
R.D.	10	Goitre +. Enlarged tonsils. Malnutrition.	2. ^x	Disappearance of goitre. Throat healthy. Nutrition improved.
G.F.	8	Goitre +.	2.	Disappearance of goitre.
C.T/				

x Indicates that Cod Liver Oil or extra milk was provided.

Initial Age in years.	Duration of goitre in years.	Notes on Case before treatment.	Number of courses of treatment with Iodine.	Result.
C.T.	12	Goitre + +. Had tonsillectomy at 6 years of age.	5,	Disappearance of goitre.
S.M.	12	Goitre + +. Enlarged tonsils.	6.	Disappearance of goitre. Tonsils healthy.
O.P.	10	Goitre + +. Chronic tonsillitis. Malnutrition.	5 ^x	Disappearance of goitre. Tonsils healthy. Nutrition improved.
L.N.	10	Goitre + +.	2.	Disappearance of goitre.
A.S.	6	Goitre + +. Enlarged tonsils.	2.	Disappearance of goitre. Throat healthy.
W.R.B.	10	Goitre + +. Dry skin. Malnutrition.	2 ^x	Disappearance of goitre. Nutrition improved.
F.D.	7	Goitre + +. Chronic tonsillitis. Malnutrition.	2 ^x	Disappearance of goitre. Throat and nutrition improved.
M.W.	8	Goitre + +. Chronic tonsillitis. Malnutrition.	2 ^x	Disappearance of goitre. Throat and nutrition normal.
F.W.	6	Goitre + Tonsillar sepsis. Malnutrition.	2 ^x	Disappearance of goitre. Tonsils healthy. Nutrition improved.
E.C.	11	Goitre + +.	2.	Disappearance of goitre.
R.D.	8	Goitre + +. Tonsillectomy at 4 years of age.	2.	Disappearance of goitre.
R.G.	8	Goitre + +. Ichthyosis of skin. Malnutrition.	2 ^x	Disappearance of goitre. Skin much improved.

x Indicates that Cod Liver Oil or extra milk was provided.

It is interesting to note that in this district I came across my only case of a cretin in a goitrous area. The family lived in the wild mountainous district of Glenlyon. The Mother, aged 45, had a medium size goitre showing small adenomata. She stated she had the goitre at the age of 10. She had 3 children:-

1st child, boy, aged 13, no goitre; intelligent.

2nd child, girl, aged 11½, no goitre; very intelligent.

3rd child, girl, aged 8, no goitre, but an imbecile and a typical cretin, showing stunted growth, prominent belly, marked lordosis, wrinkled redundant skin. The child could not speak, and could only walk when supported. It had never come under thyroid treatment.

OBSERVATIONS on TREATMENT.

The results of treatment with iodine are recorded in the above table. One course of iodine treatment consisted in giving weekly for 3 months

One Tabloid "Iodicin" (B.W.&Co) 0.03 gramme (chocolate base) - each Tabloid securing the administration of 0.01 gramme of iodine in organic combination.

Where malnutrition was present in addition to goitre, treatment with extra milk or cod-liver oil was carried out concurrently.

When the goitre had been present for more than 3 years prior to treatment and an irregularly enlarged goitre was present with or without adenomata, the goitre remained/

remained unchanged. Treatment with iodine, however, resulted in the cure of the chronic tonsillitis.

When goitre was present for 3 years or less prior to treatment and there was no irregular enlargement or cysts, treatment with iodine resulted in

- (1) a cure of the chronic tonsillitis.
- (2) a disappearance of the goitre.

It was however apparent, if one failed to treat the accompanying malnutrition at the same time (which was present in 16 out of 32 successful cases) one could not hope for a cure of the goitre. The treatment of malnutrition consisted in the administration daily of $\frac{1}{2}$ -oz. of cod-liver oil or $\frac{1}{2}$ pint milk. Advice was given to the parent in all cases of goitre when treatment was instituted, as to diet, more milk and green vegetables, with some additional animal protein and butter, being advocated. How far this was carried out, it was impossible to say, but an attempt was certainly made as far as the family means would allow, in the majority of cases.

That goitre can disappear spontaneously is probably true, but I have no experience of this, as, on the first signs of an incipient goitre, I advised a more suitable diet. In necessitous cases, and cases in which the goitre did not improve on this advice, which may not have been followed, iodine treatment, and extra nourishment if indicated, was carried out.

I have records of several incipient goitres dis-
appearing with no other treatment than a suitable
dietary.

CORRELATION BETWEEN IODINE SUPPLY and INCIDENCE OF
ENDEMIC GOITRE.

The results of investigations into the above
correlation have been reviewed by Orr and Leitch⁽¹⁾
McClendon and Hathaway in America (1924), V. Fellen-
berg in Switzerland (1925), and Hercus, Benson and
Carter in New Zealand (1925), found an inverse
correlation between the iodine content of drinking
water and of foodstuffs, and the incidence of goitre.
These results have not been confirmed, so far, in
this country.

I have endeavoured to show, however, that there
is a distinct lack of iodine containing foodstuffs,
such as milk, eggs, and green vegetables, in the diet
of rural children in this area.

In his analysis of geological formations for
iodine content, V. Fellenberg⁽²⁾ has shown that cre-
taceous soils are lowest in iodine content, and
Jurassic highest.

Nevertheless, in this area, there is as high an
incidence/

(1) Orr and Leitch, "Iodine in Nutrition" 1929.

(2) Orr and Leitch, "Iodine in Nutrition" 1929, p.11.

Fellenberg
quoted in

incidence of goitre on the Jurassic as on the cretaceous formations. (See map).

If lack of iodine in foodstuffs be a factor in the causation of goitre, it would appear better treatment to administer iodine containing foodstuffs, such as green vegetables grown in iodine rich soils, than iodine in tabloid form.

It cannot be held proven that deficiency of iodine is a cause of goitre because spectacular results follow treatment of goitre with iodine.

CONCLUSIONS.

I will now sum up the points upon which I have tried to lay stress:-

- (1) In this area, there is evidence to show that goitre incidence in children is associated with water supplies from cretaceous formations.
- (2) These water supplies contain in suspension mineral matter of a calcareous nature.
- (3) There is no evidence in this area to show that contaminated water supply is a factor in the causation of goitre.
- (4) The class of child liable to attack with goitre is the mal-nourished child of the agricultural worker.
- (5)/

- (5) This subnormal nutrition is due to a deficient dietary lacking in vitamins.
 - (6) Simple goitre in early life increases the numbers of "dull and backward" children.
 - (7) The goitrous child is often handicapped in later life on account of his liability to disease and lowered mentality.
 - (8) If malnutrition were prevented or treated in the pre-school period, the number of goitrous children would be small. The rural worker should be instructed in a more suitable dietary for his children.
 - (9) That treatment of malnutrition in early goitre is of primary importance.
 - (10) Diseased tonsils herald the onset of goitre, and tonsillectomy is harmful in these cases.
 - (11) Iodine is definitely curative of such diseased tonsils and early goitres, provided malnutrition, if present, is treated at the same time.
-

The data for this Thesis was collected between March 1928 and March 1930. Since compiling it, McCarrison, experimenting with rats, has recently shown, among other things, that faulty food, deficient in vitamins, was a direct, or indirect, cause of goitre. D.P.M.

McCarrison - "A Goitre Survey in Albino rats"
British Medical Journal R939.
May 31st. 1930.