GOITRE IN A SOUTH WALES VALLEY

by

WILLIAM SIMPSON.

GOITRE IN A SOUTH WALES VALLEY.

I. INTRODUCTION.

II. THE PRESENT POSITION.

- (a) Geographical distribution.
- (b) Classification.

III. THE LOCAL POSITION.

- (a) Prevalence of goitre in the district.
- (b) Clinical types of goitre.
- (c) Clinical course.
- (d) Local notions as to the causation of goitre.
- (e) Local methods of handling goitre.

IV. ETIOLOGY.

- (a) The influence of diet.
- (b) Iodine as a factor.
- (c) Lime as a factor.
- (d) The influence of infection.
- (e) Vitamin deficiency as a factor.
- (f) Industrial influences.

V. DEDUCTIONS.

- (a) Incidence.
- (b) Agencies bringing about goitre.
- (c) Prophylaxis.

I. INTRODUCTION.

Goitre is a disease which is prevalent in many countries in all parts of the world. Its existence has been recognised for thousands of years, and it remains one of the commonest conditions to be seen in medical practice at the present time.

As a newcomer to Aberdare, the writer was immediately impressed by the fact that thyroid swellings were extremely common. They were to be seen everywhere, and they excited no comment. Further investigation showed that a definite proportion of the population suffered from this malady.

The town is one of the mining towns of South Wales. There are no other industries of any importance. The subjects of the investigation are patients in a large general practice. It will be the endeavour of this article to try to explain why goitre should be so common in this locality, and this neighbourhood alone will be considered.

As the investigation was carried out in general practice, the findings are the result of clinical examination entirely, histological examination being out of the question except in the few cases where operative assistance was necessary.

Dr Pritchard, Medical Officer of Health for Aberdare, provided the data regarding the Water Supply and offered every assistance in its investigation.

The Clinical Research Association performed the estimation of the Iodine and Calcium contents of the water from the local reservoirs, and of the soil.

II. THE PRESENT POSITION.

The existence of goitre has been recognised for many centuries. Even before the days of ancient Greece, sponges and seaweeds were used in its treatment. It is still a very frequent source of disability and discomfort and is responsible for much ill-health.

It occurs as an endemic, epidemic or sporadic disease. In some districts it is never absent. In others epidemics of short duration have been recorded.

The incidence of goitre is related to different factors in various districts. Some types appear to be brought about by a high percentage of lime salts in the water supply. The prevalence of the condition in other districts is often related to a combination of factors, among which an infected drinking water, a deficient iodine intake, and insanitary conditions of life are important.

Heredity appears to play a part in many places.

Any final statement as to the cause of goitre in any one area must take all these influences into consideration.

Many observers have pointed out that the disease is rare near the sea, and becomes more and more common as the distance from the sea increases.

The fact that, even in these places where goitre used to be markedly endemic, the more serious manifestations of the disease, such as idiocy, cretinism and deaf-mutism, are now rare, is of importance. This is attributed to an improved standard of life, protection of water supplies and improved sanitation. Only in the remotest parts of hilly districts do the gravest sequelae of goitre now result.

(a) Geographical Distribution.

Switzerland is the country where goitre is most common. In France, in the Alpine districts, it is frequent. In Spain, the valleys of the Pyrenees provide foci. In Norway and Sweden a few goitre areas occur.

In India in the Himalayas, the condition is very common.

In the United States there are several extensive goitre areas. The more important ones are those in the Northwestern States, a large area around the Great Lakes, and in the upper Mississippi valley.[1]

In England, the classic home of goitre is Derbyshire but the disease is very frequent in Somerset, Sussex, and Hampshire. In Wales, the mountainous districts of Mid-Wales provide many examples, and many cases are met with in the Swansea area.

Most of the goitre areas are hilly or mountainous districts.

(b). Classification.

In describing a number of cases of goitre some definite classification must be adopted. As the majority of the patients examined in this series are now pursuing their ordinary occupations it is obvious that the classification must be a clinical one. The classification advocated by Zimmerman [2] appears to meet these requirements.

(1) Diffuse non-toxic goitres.

This group includes diffuse hyperplasia of the thyroid both in adolescents and adults, and colloid goitre.

(2) Non-toxic adenomatous goitres.

This group includes the nodular or adenomatous forms, varieties of which are the cystic, the haemmorhagic, the fibrous and the calcified. These sub-varieties can seldom be differentiated clinically, but most authorities are convinced that they are merely different manifestations of the same process, varying with severity, duration and age.

(3) Toxic goitres.

This includes the diffuse or primary exophthalmic goitre, and the nodular or toxic adenoma. The first type occurs in younger people and is relatively acute in many cases. The second type is

found in older people, and runs a much slower course, often extending over a number of years. It is apt to be complicated by cardio-vascular degeneration which may be due in part to the thyroid and partly to the natural wear and tear of life.

Again there is no absolute way of separating these two types of toxic goitre. Cases of undoubted exophthalmic goitre are seen, and other cases of definitely toxic adenomata occur. Between these two extremes, there are many cases where it is impossible to say dogmatically that they belong to one or other group.

III. THE LOCAL POSITION.

(a) Prevalence of goitre in this district.

A newcomer to this district at once receives the impression that goitre is extremely common.. Thyroid swellings are commonplace sights in the streets, so much so that no attention is paid to them by the inhabitants. They are looked upon as something in the natural course of events. "It never troubles me," the people say.

Owing to this casual acceptance of the condition, it is difficult to obtain statistics. Practically without exception the cases which were investigated came to the surgery complaining of something entirely different. Hospital records, too, give a misleading impression, as these patients are not admitted to hospital for treatment. Indeed, it is with difficulty that they can be persuaded to accept any treatment as they feel perfectly well.

A series of thirty cases was examined. This included five cases of children with congenital goitre. The hyperplasia of adolescence was not included.

The proportions are as follows:-

Adenomata	- 22	=	88%
(non-toxic	- 16	=	64%)
(toxic	- 6	=	24%)

Colloid goitre - 1 = 4%

Exophthalmic goitre - 1 = 4%

Malignant goitre - 1 = 4%

As only one case presenting the signs of malignancy was seen, the comparatively high percentage is perhaps misleading.

In this practice 2% of all patients have thyroid swellings. If one excludes adolescent goitres, which are common here, but not more so than in other districts, 1.5% of the patients are the subject of goitre. Women are affected in an overwhelming majority, in the ratio of 9:1, perhaps a larger proportion than in other districts.

(b) Clinical types of goitre.

The cases from which the following data are drawn occur in a mining district in a South Wales valley. Aberdare is situated in the most southern part of the Welsh hills, and is about 400 feet above sea level. The water supply is a soft water, and, as will be shown later, contains little or no lime.

The prevailing type of goitre is the non-toxic adenoma or adeno-parenchymatous type. It makes its appearance on an average at the age of 33 years, the age varying in different cases from 12 years to 49 years of age. In these subjects of goitre who

have developed the complaint after coming to the district, the average lapse of time before the onset of the thyroid swelling is fourteen years.

The adolescent type of goitre is moderately common in girls about the age of puberty. I do not recollect having seen a boy similarly affected. These swellings disappear spontaneously without treatment. In this series of cases the adolescent type has not been included, as the majority are transitory, and cannot be regarded as pathological in any way.

Colloid goitre does not appear to be common. While we cannot definitely distinguish between this type and the adeno-parenchymatous type without histological examination, which is out of the question in general practice, and while it is agreed that the various types may merge insensibly one into the other,[3] practically every swelling has palpable nodules in some part of the gland. The colloid type of goitre is supposed by many authorities to be associated with the ingestion of large quantities of calcium salts. This factor is lacking in the district under review.

Congenital goitre is rare. Five cases were examined, however. In two of these cases, the goitre disappeared spontaneously at the age of four months

and two years respectively. The other three children, aged fourteen and a half, thirteen, and five respectively, showed well marked firm goitres. They had been fed on proprietary foods. The oldest child of that family had been breast fed, and did not suffer from goitre. The mother was the subject of an adenomatous growth of the thyroid.

Cretinism appears to be absent. No definite case has been seen.

Exophthalmic goitre is extremely rare. Only one case was seen in the series, and this in a male patient. This type appears to correspond to the colloid variety of goitre, and to be more prevalent in low lying districts near the sea.

Malignant disease of the thyroid is rare. Only one case affording clinical evidence of malignancy was seen. The percentage must be extremely small. Dunhill[4] states that 1.7% of patients operated on because of thyroid swellings show signs of malignancy but in many of those cases, the clinical signs of malignancy were absent.

(c) Clinical Course.

The adeno-parenchymatous type appears at the average age of 33 years. It occurs as an isolated nodule, usually in the right lobe, and may be associated with general thyroid enlargement. It generally

causes no symptoms, and there is no discomfort. The only complaint is of its disfiguring appearance.

The symptoms of myxoedema are lacking. These subjects are not unduly sensitive to cold, their skin and hair is healthy, and while many of them are rather obese, they affirm, practically without exception, that they were much stouter before the onset of the goitre, and that since its appearance they have lost, rather than gained in weight.

One symptom is practically universal in women patients. They complain of menorrhagia, and say that the menstrual periods have become more frequent since the onset of the goitre. They complain also of copious bleeding after the termination of labour, but only one in the series gives the history of having had post-partum haemmorhage. In the older patients the climacteric appears to be delayed and menstruation is not uncommonly still regular after the age of fifty years.

Toxic symptoms are a feature of the prevailing type of goitre in this area. The time of onset is given variously as from five to twenty-six years after the first appearance of the swelling, with an average of eleven years. They complain of palpitation, dyspnoea, trembling, sweating and sleeplessness. These symptoms are more marked in middle-aged patients. In older patients the symptoms are almost entirely those of cardiac degeneration.

It is generally affirmed that there is no hard and fast dividing line between exophthalmic goitre and true adenomata. While both show tachycardia, nervousness, tremor, sweating and increased resistance to cold, in this district at least they can be distinguished, as the subjects of true adenomata generally show a marked absence of emaciation.

The cardiac symptoms take the form of tachycardia, dyspnoea, cardiac irregularity and increase of blood pressure. This increase appears to be mostly in the systolic reading, so that the pulse pressure is large. This has the effect of giving extremely high positive readings when the basal metabolic rate is estimated by Reed's formula. One is forced to conclude that in older patients at least, Reed's formula is not reliable, as tachycardia and pulse pressure may be increased by other factors, apart from, or in addition to the increase of metabolism of thyroid origin.

Generally speaking, however, toxic symptoms affect the nervous system in middle-aged patients, the cardio vascular system in older patients.

The "eye signs" described so frequently as a feature of exophthalmic goitre are completely lacking in this type. In the cases in which goitre has been present for twenty years or over without general symptoms, there is a tendency for the gland to become

stationary in size. In none of the patients under observation, however,has the swelling become smaller.

Pressure symptoms are much less common than toxic symptoms. The growth enlarges outwards. The average time of onset in this series is sixteen years after the first appearance of the swelling. This type of goitre may be present for twenty, thirty or forty years and may cause few symptoms, the patient dying from some other cause. In many cases, however, the subjects develop cardiac failure. Congestive heart failure is not a feature and apparently the left side of the heart is principally involved.

(c) Local Notions as to the Causation of Goitre.

The majority of the patients are unable to give any reason why they should be affected by enlargement of the thyroid. In most cases they were unconscious of the presence of any enlargement until their attention was drawn to it by others.

One or two, however, state that in their opinion, the cause of the growth was the carrying of weights on the head during childhood. Several were in the habit of carrying buckets of coal for some distance in this fashion.

Others, notably those from outside districts, appear to think that a "hard" water supply was responsible, and one described the water of her native place

as "limey from the clay." Another thought that the water supply from a spring was responsible.

Local medical men are strongly of the opinion that the falling-off in frequency of goitre during the last twenty years is due to the installation of efficient filter-beds at the town reservoir. They think that some factor - infection or otherwise - must have been present in the water at that time. The water is very soft and is now artificially hardened by the addition of calcium salts.

Lay people do not appear to attribute the condition to the water supply. They regard it as a natural event.

(e) Local Methods of Handling Goitre.

Adolescent hyperplasia of the thyroid in the majority of cases disappears spontaneously without treatment. In those cases in which the swelling does not subside naturally, Tinct.Iodi mj.iii t.i.d. is given for a fortnight. This generally causes the swelling to subside. In the other cases some reduction of size was produced, although some enlargement remained. These must be regarded as candidates for goitre.

In no case have the symptoms of toxicity followed the use of iodine in this type.

Adeno-parenchymatous goitre does not respond to any treatment. The giving of small doses of iodine produces slight reduction in size in some cases. In two cases, however, symptoms of hyperthyroidism appeared following the giving of Lugol's Solution. One of those showed a basal metabolic rate of +23 (Reed's formula), extreme nervousness, vomiting and prostration. This necessitated confinement to bed.

When adenomata are easily palpable, operative treatment is effective, the localised swelling being dissected out, or if cystic, shelled out. This is sometimes followed by the occurrence of a haematoma in the neck, in spite of apparently efficient haemostasis and drainage. The indurated swelling is absorbed in a few days, however, and the end result is good.

Toxic symptoms demand complete rest in bed. It is customary to keep these patients on a milk diet. Although this is theoretically a protein high diet, in practice it is quite satisfactory, and is certainly the most convenient diet for treatment at home.

Bromides usually allay the nervous symptoms in a short time. If this is without avail Liqur. Morphine Hydrochloride mj. V t.i.d. usually has the desired effect. Iodine is not given. In very bad cases morphine may have to be given hypodermically.

The cardiac symptoms are treated by the exhibition of digitalis along with the bromide mixture. Drugs are not given to lower the high blood pressure of elderly patients, but this condition is treated on general lines.

Digitalis acts by slowing the pulse rate and increasing the efficiency of the cardiac contractions. In middle-aged patients, where tachycardia is marked, but where the pulse is regular, the heart responds fairly rapidly to comparatively small doses.

In the older subjects, however, where extrasystoles are present as the result of thyroid or other influence, its effect is much slower, and larger doses are required. When there is marked irregularity, it does not appear to have very much effect at all. Indeed, in such a case, no drug has any beneficial effect, and the treatment is entirely palliative. In middle-aged patients, however, small doses of digitalis, combined with a fortnight's rest in bed, appear to be all that is required to tide the patient over the attack, and she is generally able to go about in three or four weeks.

It is found, as one would expect, that the middle-aged subjects of true adenomata respond fairly readily to treatment, but the cardiac symptoms of older patients become gradually progressive, the heart becomes more and more irregular, and they die from myocardiac failure in spite of treatment.

IV. ETIOLOGY.

Various factors must be investigated in considering the etiology of goitre in any district. They are:-

The type of diet.

The influence of iodine.

The influence of calcium.

Water.

Infection.

Accessory food factors.

Heredity.

The question of diet will be considered first of all, because a knowledge of the constituents of the diet is necessary before considering the other factors.

(a) The Influence of Diet.

It is a well known fact that the mining classes depend largely on a carbohydrate diet for the following reasons:-

(1) Its cheapness

(2) Its ease of preparation

(3) Its suitability as a fuel to replace the energy which is so freely expended during work.

A typical diet is as follows:-

Breakfast:- Tea, bread and butter, jam, occasionally bacon.

Lunch :- (taken in the pit) Slices of bread and butter or margarine. They usually drink tea or water which is carried in the quart "Jack."

Dinner :- Potatoes, cabbage, tea, bread & margarine and occasionally meat, tinned meat, or salmon.

Supper :- Tea, bread and butter or margarine. Fruit pastries, when in season.

Sunday is the only day of the week on which a really varied diet is taken. Meat, potatoes, and cabbage, peas or beans, practically always form the mid day meal, but the week day dinner is composed of large quantities of potatoes and a very small portion of meat or bacon.

Fish is rarely to be had. Green vegetables are not in common use, with the exception of cabbage. Condensed milk is used instead of whole milk. Margarine is used instead of butter. Milk and milk products do not form a part of the diet. Oatmeal is practically never used. Tinned salmon is frequently seen as it is cheap and does not require any preparation.

The diet may be presented much more vividly in tabular form, the articles of the diet being placed in the order of frequency.

	Breakfast.	Lunch.	Dinner.	Supper.
1.			Potatoes (invariably). Boiled or fried, in large quantities.	
2.	Bread & margarine, or butter.	Bread & margarine.	Bread & margarine.	Bread & margarine.
3.	Tea.	Tea or water.	Tea.	Tea.
4.			Cabbage - well-boiled. (Very often)	
5.		Cheese.		
6.	Eggs.			
7.	Jam (factory made)			Jam (factory made)
8.	Bacon.		Bacon.	
9.			Tinned salmon.	
10.			Tinned meat.	
11.				Fruit pastries (in season)
12.			Milk (rarely)	
13.			Fresh fruit (rarely.	
14.			Fresh green vegetables (extremely rarely).	

This diet is adopted, not from choice, but because economic circumstances force the people of the mining districts to adopt a diet which is at the same time satisfying, calorie producing, and cheap.

It will be seen at once that the diet is to all intents and purposes a carbohydrate one, and that the food-stuffs have one thing in common. The foods which are richest in iodine are fish and shell fish, both fresh and tinned, eggs, nuts, milk and milk products, fresh fruits and green leafy vegetables. On the other hand foods poor in iodine are, white flour, white rice, tapioca, boiled root and other vegetables (including potatoes, cabbage, turnip and rhubarb), skimmed or poor milk, beef, bacon, sugar, marmalade, jam.

It will be noted that the miner's diet is composed largely of those foods which are poor in iodine. This question will be discussed later.

One will see also that the foods which are iodine poor also happen to be vitamin poor.

The diet is therefore deficient in more than one respect.

It cannot be too strongly urged that many working people are living on diets which are grossly deficient both as regards quantity and quality. While this state of affairs is more marked than usual at

the present time, poverty is always present to some extent in this district where industrial strikes are frequent, and which depends on fluctuations in trade in other countries for its prosperity or otherwise.

Incidence in Women.

It is an accepted fact that an overwhelming majority of the subjects of goitre are women. Various authorities place the ratio at 6:1, 7:1 or even 8:1. This district is no exception to that rule, the ratio here being 9:1. How can one explain this fact?

The men are muscular and wiry. The women, however, are adipose in the extreme. The diet which for economic and physiological reasons has been found to be best suited to the men-folk, is taken by the women as a matter of course. It is not suitable for them as, from necessity or choice, they do not take a corresponding amount of exercise. Their habits are sedentary and stay-at-home.

It has been affirmed that goitre may arise in adult animals whose diet contains an excess of proteins or of fats. (M'Carrison 1919, Mellanby 1921, Marine 1924) (M'Carrison[5]).

The diet in this district contains an excess neither or proteins nor of fats. The body tissues, however, contain a large supply of unused fat. Can it not be that here is an explanation of the overwhelming majority of women subjects of goitre? It

is interesting to note that 90% of the women give the history of having been very fat before the onset of the goitre.

It has been pointed out by Cobb[6] that the life of each cell of the body, considered as an individual, is a relatively short one. It serves its purpose, degenerates, and is excreted from the body by one of the normal channels. For this to be performed, however, in a normal manner, the presence of thyroid secretion is necessary; for in its absence, cell elimination does not follow its usual course. Hence the vast increase which is present in myxoedema. As is well known, this gives rise to oedema, or to be accurate, increased subcutaneous tissue which puts on pressure.

When there is a large amount of tissue, a large amount of cell elimination with a corresponding amount of thyroid secretion is demanded. When there is an excess of tissue the amount of thyroid secretion may be inadequate. The thyroid gland becomes hyperplastic, and remains so as long as there is a demand for its secretion. Marine[7] has shown that the colloid stage is the nearest return to normal that a hyperplastic gland can attain. Although the colloid type of enlargement is not very common here, we cannot avoid the conclusion that this series of events may account for some of the cases of persistent enlargement of the thyroid gland in women.

(b) Iodine as a Factor.

The secretion of the thyroid is thyroxin which contains 65% of iodine. Kendall has isolated another active substance from the thyroid containing about one-half of the total iodine of the thyroid proteins. This substance has no effect on the metabolic rate, but is concerned mainly with the nutrition of the skin. It is thus seen that the gland contains a large proportion of combined iodine which is essential to its functional activity.

In the absence of the thyroid, iodine accumulates in the blood while the giving of thyroid substance restores the amount of iodine in the blood to normal limits.

According to Bourcet[8] one-third of a milligram of iodine is ingested daily in the food. This replaces that absorbed from the blood to take part in the formation of thyroid secretion.

It is recognised that iodine is essential to the body. In its absence, goitre may result, either from that deficiency alone or because of that deficiency combined with some other factor.

Iodine may fail to reach the gland in one of three ways:-

(1) It may be lacking in the food or drink.

(2) It may not be absorbed from the bowel.

(3) It may be absorbed from the bowel, but the thyroid gland, for some reason, is unable to make use of it.

(1) As we have seen certain foods contain much iodine, others contain little or none. McCarrison[9] states that "Sophisticated foods such as white flour "contain little or no iodine: while most vegetables "grown on soil fertilised by artificial manures not of "marine origin are deficient in this element."

This district is twenty miles from the sea. The fertilisers used are for the most part artificial, and the vegetables, when not home produced, come from the neighbouring inland county of Breconshire.

We have seen that the daily diet of this district is composed of foods which contain little iodine and is poor in foods which contain a larger quantity. Without doubt, it contains some iodine, but while it may supply normal needs, it can not supply any additional quantity should an abnormal demand arise.

The iodine content of the soil is -

30 parts per 10,000,000.

Less than 5 parts iodine per ten million indicates a low iodine content of the soil.

A moderate quantity of iodine in the soil is 25-45 parts per ten million.

100-400 parts per ten millions would indicate a soil rich in iodine.

The richness or otherwise of a soil in this mineral is reflected in the iodine content of the vegetables grown upon it.

The iodine content of the water is -

0.02 parts per 10,000,000.

The water, therefore, is practically iodine free.

From these facts it is obvious that the iodine content of the food, the water and the soil is low.

In this connection it is interesting to note that McLendon and Hathaway[10] found that foods produced in goitrous regions contain less iodine than foods produced in non-goitrous regions.

(2) When one comes to examine the possibility of deficient absorption of combined iodine from the intestine, one is on less certain ground.

M'Carrison[11] in 1927 conducted experiments on pigeons, feeding them on a diet of milled rice - an iodine-poor food, - and found that while a certain proportion of them developed large hyperplastic goitre, the majority did not.

Again, many observers (Marine and others) have shown that experimental animals kept in such circumstances that their food may be contaminated with their excreta, may in course of time develop goitre.

A further step was that of McLendon[12] who in 1927, showed that bacteria are capable of removing iodine from organic media containing it.

It has been proved that the amount of iodine which suffices to keep these animal subjects of experiment in health where conditions are hygienically perfect is much less than the amount which is necessary when there is a possibility of contamination of the food (McCarrison[13]). That is to say, the more unhygienic the conditions, the more is iodine required to counteract these conditions.

These experiments by various observers tend to show that the occurrence of goitre is associated in some way with a deficient ingestion of iodine in many cases. This does not invariably result, however, but when it is associated with some other factor, a diet deficient in iodine must be regarded as an important contributory cause.

We have seen that the intake of this element is small in the majority of mine workers in this district. One has now to prove the presence of the complementary factor which is thought to be bacterial by most writers on the subject.

(c) Lime as a Factor.

It has been recognised by many authorities that the presence of a "hard" water supply and a high goitre incidence go hand in hand. It is often stated by the laity that goitre is due to lime in the water. Its presence appears to act as an influence in

some cases, but in other districts, despite a high calcium content of the water, goitre appears to be relatively scarce.

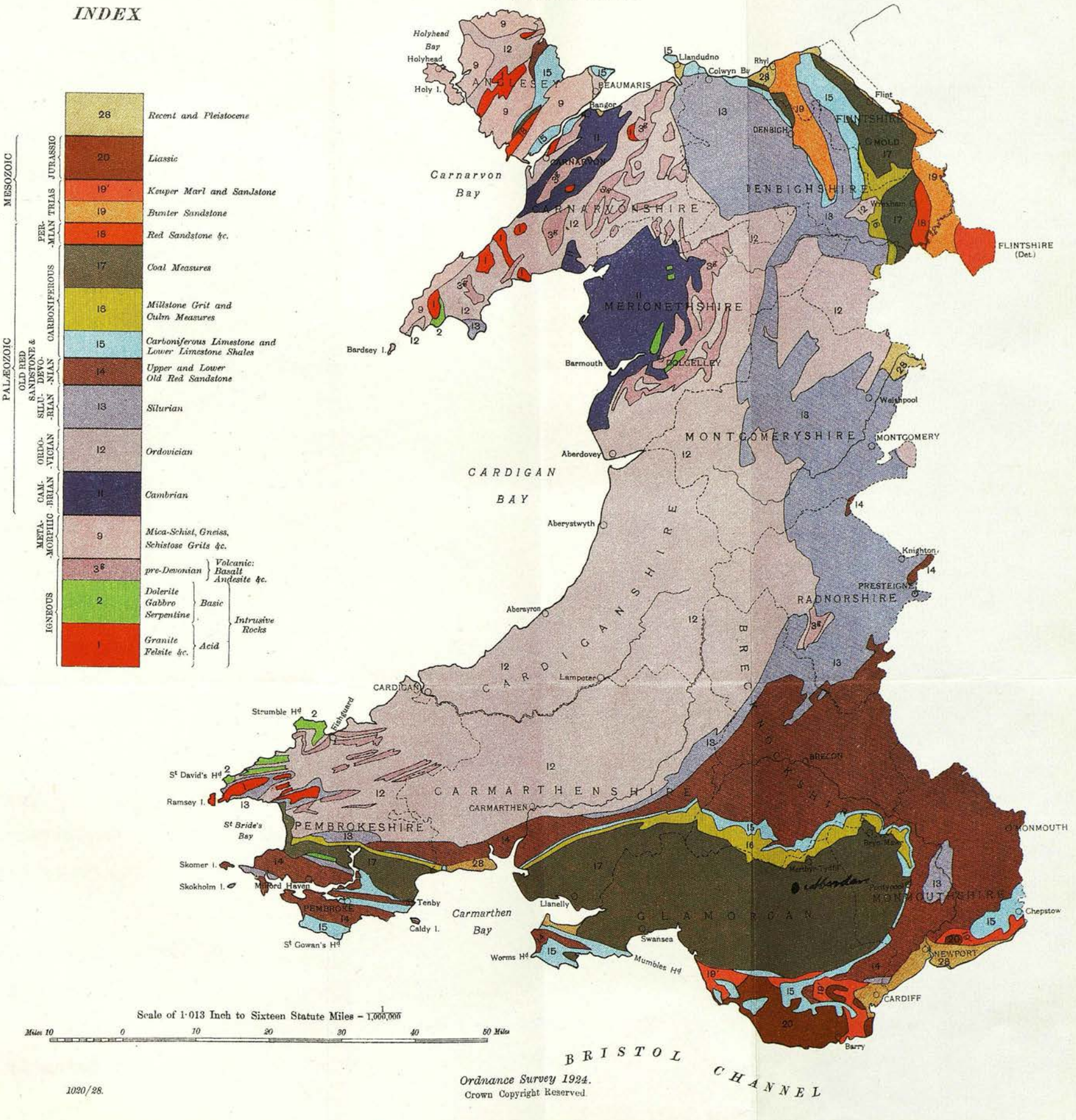
Experimentally McCarrison[14] has fed animals on a food containing excess of lime, and produced in them goitres where colloid storage occurred to the exclusion of active secretion. But, he says, this is not due to lime alone. This picture is not seen unless the excess of lime is accompanied by a deficient iodine intake, while it is prevented by the additional provision of iodine in the food. These conclusions were drawn as the result of animal experiments in India. It does not necessarily follow that a similar state of affairs holds good in man, in that country or in this.

Stocks[15] has shown that the incidence of goitre is greatest where the strata of Devonian, Triassic or Carboniferous Limestone are outcropping. He states that there is a high incidence in a belt extending from Cornwall, north-east through Somerset, between the Cotswolds and the Chilterns, up into Derbyshire, and on to the Pennines. This zone between 500 and 1000 feet above sea level is most affected.

A study of the geology of this district is of interest. South Wales is a coal-mining district, and the coalfield is extensive. The Coal Measure extends as a large belt from Monmouthshire, west through the

WALES including MONMOUTHSHIRE

GEOLOGICAL MAP.



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whole of Glamorgan as far as Carmarthen, where it reaches the sea at Carmarthen Bay. It is roughly eighty miles long, and twenty five miles wide. It is completely ringed round by an outcrop of Carboniferous Limestone. This may be compared to a saucer whose edge comes to the surface - technically outcrops - round the outskirts of the coal bed. The coal field itself may be compared to the contents of the saucer.

This geological formation has been noted for hundreds of years, and as long ago as 1595 was described by George Owen [16] of Pembrokeshire. Smeaton [17] in 1791 traced the distribution of the Lias from the Glamorgan coast, through Monmouthshire into Nottinghamshire. (Lias is the name given by Somersetshire quarrymen to the rocks consisting of alternate layers of lime and shale.) In fact the outcropping of the Carboniferous Limestone layers is so notable in this area that this encircling band has been described as Derbyshire Limestone.[18] On examining a Geological Survey map of England and Wales one sees the most extensive outcrops of this layer in South Wales, North Wales and Derbyshire.

It is evident that the areas which have a soil of this nature correspond largely to the belt of goitre incidence described by Stocks.

The particular district under review, however, is situated well inside the Coal Measure, about five

miles from its northern border, but not far removed from the limestone district.

One notes that in the towns situated in the limestone belt (Merthyr, Brynmaur, Crickhowell, Abergavenny, Hereford) goitre is exceedingly common. It is interesting to note also that those towns are mostly above 500 feet above sea level.

In this district, however, hard water or excessive calcium intake in the food can not be regarded as a factor. The town reservoirs are situated well inside the area of the coal bed, and the water is remarkably soft.

The quarterly analysis[19] of the water supply reported "Total hardness 1.5 parts per 100,000," and goes on to say "A very soft water."

Clinical Research Association reporting on a specimen taken on August 6th 1931, states:-

Calcium as Ca O 3.59 parts per 100,000.

The softness of the water is, in fact, so pronounced that the water occasionally causes solution of the lead from the water supply pipes. This caused an epidemic of lead poisoning twenty-five years ago. The water is now artificially hardened by the addition of calcium. Even so, the quarterly analysis occasionally reports the presence of dissolved lead in small amounts.

While this fact may in part help to account

for the great frequency of nephritis and pregnancy albuminuria in this area (cf. Milligan B.M.J. 28th August 1926 pp.374) one can not look upon it as a determining cause in the occurrence of thyroid enlargement.

Goitre used to be much more common in this district than is the case at the present time. This has been attributed locally to the artificial hardening of the water. It is more likely that there are other reasons for the lessened frequency.

McCarrison [20] has pointed out that the colloid type of goitre is very frequent in those places where there is an excess of lime in the food and drink, and suggests that it is due to a disturbance of the calcium-iodine balance in the food. The goitres seen in the limestone districts of Hereford, Cardigan and Carmarthen are of the colloid as well as of the adeno-parenchymatous type. The colloid type is much more frequent than in this district.

One may conclude therefore, that the presence of limestone areas is one of the factors in the occurrence of enlarged thyroids in many localities in South Wales, but is not a factor in this particular district.

(d) The Influence of Infection.

The presence of bacterial infection, slight in itself, but long continued may cause the gastro-intestinal tract to become a resting place for bacteria. McLendon has shown that bacteria are capable of removing iodine from organic media containing it. An increased iodine intake may prevent the appearance of goitre even where there is well marked bacterial infection. It is readily seen that experimentally at any rate the presence of bacterial infection is a link in the chain of the occurrence of goitre.

The diet is also a vitamin deficient one. This will be discussed later. Bacterial infection would accordingly have a fruitful soil.

One must look, therefore, for sources of infection. They are many. The most striking ones are:-

(1) The mouth and teeth, notorious everywhere as a point of origin of infection, is a particularly potent focus in this district, aided, no doubt, by the lack of calcium in the water.

(2) The quarterly analysis of the water supplied to the district gives the following report:-
"B.coli organisms isolated from 10 cc. &
"50 cc. of water; no coli-like organisms
"present in 2 cc. or smaller amounts. Of

"moderate bacterial purity." This in itself is not of much importance but may be regarded as a link in the chain.

(3) In this area outdoor closets, without any water supply, still exist. They are now diminishing in number, but used to be very common. One can readily imagine that adequate washing facilities would be correspondingly deficient. Twenty-two out of twenty-five cases lived in houses where the sanitary arrangements were of this type.

The frequent occurrence of gastric and duodenal ulcers, and of acute, even fulminating, appendicitis, may be taken as proof that infection of the gastro-intestinal tract is present. These maladies are not in any way confined to this district, of course, but are certainly not less common here than elsewhere.

The fact that the ingestion of infective material is one of the factors in the causation of goitre has been proved by many authrities in experiments on animals (Marine & Lenhart 1910, Bircher 1911, Gaylord 1912).

Marine found that hyperplastic goitre resulted when artificially reared trout were confined in tanks placed one above the other, so that the out-flow from

the upper tank flowed into the one below it in the series. The number of fish affected increased from the first to the last tank. The fish were fed on liver - a fat rich food.

Gaylord conducted a similar experiment, with similar results, but went a step further, and found that the goitre so produced was cured by the addition of iodine, arsenic, or mercuric perchloride to the affected water. Apparently these substances acted by virtue of their antiseptic properties.

In 1906, M'Carrison supplied the most conclusive evidence of the part played by infection. Eight villages lay along the banks of a stream. Goitre was prevalent in all of them, but the incidence increased progressively, the further down the stream the village lay. In the last village, there were four times as many subjects of goitre as in the first village. Goitre was not endemic in the ninth village, which received its water supply from a different source.

M'Carrison therefore fed to a number of volunteers a filtrate of the water from the contaminated stream. 41% of those consuming the unboiled filtrate developed nodular goitres. None of the volunteers who took the boiled filtrate developed goitre.

He concluded that a "contagium vivum" was the responsible factor in that district, and that it could be removed by filtration through a Berkefeld filter.

Experimental evidence therefore shows that bacterial infection of the gastro-intestinal tract plus a deficiency of iodine in the water and in the food are most important influences in the production of goitre.

The diet of this district is deficient in iodine; the water contains practically no iodine, and sources of bacterial infection of the intestinal tract are not lacking. To my mind it appears clear that here are the causes of the frequent occurrence of goitre in the Aberdare district.

(e) Vitamin Deficiency as a Factor.

We have seen that the daily diet of this district is an iodine-poor one, and also a vitamin-poor one. It contains little in the way of fresh fruit or vegetables, milk or milk products.

In a recent article in the British Medical Journal, M'Carrison[22] emphasised the fact that a diet which is deficient in Vitamin A plays in the production of infection of almost every system in the body in albino rats. These animals he considered to be most closely related to human beings in their response to infection.

The diet which produced the varied infections closely resembles that described above. "I may add "that of all the faulty diets I have used, that

"composed of white bread, tea, sugar, jam, preserved "meat, and scanty, overcooked vegetables - a diet in "common use by many people in this country - proved "to be one of the worst, and most likely in rats to "be associated with the many morbid states I have "mentioned."

The same observer goes even further into the question of avitaminosis as a factor in the production of goitre. He states definitely that lymphadenoid goitre does occur as a result of this diet. It does not occur at once but occurs "in its own good time."

This type of goitre is defined as the hypertrophic reaction of a physiologically inefficient organ, with which there occurs a preponderance of lymphocytic aggregates, fibrosis, and a peculiar atrophy of the parenchyoma (Williamson & Pearse 1925). This pathological condition has been described in man.

It has been shown that as the result of a food deficient in Vitamin A. a certain type of goitre occurs in rats. It has been demonstrated that an identical condition may occur in man. Surely it is not unreasonable to suppose that a closely related diet may be a factor in some of the types of goitre one sees in this locality.

(f) Industrial Influences.

In many districts the prevailing diseases are caused by, or are in some way related to, the industries of that neighbourhood. In this locality, for instance, the prevalence of "miner's asthma" and the different varieties of fibrosis of the lung with their consequent pulmonary tuberculosis, are undoubtedly caused by working in a dusty atmosphere.

I do not think that the occurrence of goitre in this district is caused by the conditions under which the work is carried out. As has been shown the malady is overwhelmingly more common in women. Men are rarely affected.

The economic question, however, is an important one. A generous, mixed diet would do more than anything else to eradicate the condition.

Anxiety and worry are stated to be the causes of goitre of the exophthalmic type. The people undoubtedly have cause for anxiety and worry, but exophthalmic goitre is not common.

I do not think that the industrial factor is a cause of goitre, except indirectly, in this district.

V. DEDUCTIONS.

(a) Incidence.

(1) Goitre is endemic in this district but only to a slight extent.

(2) The absence of cretinism and mental deficiency attributable to thyroid disease in children tend to support the view that the degree of endemicity is slight.

(3) There is some local influence which frequently causes the appearance of goitre at the average age of thirty three years.

(4) This agency often causes goitre in newcomers to the district, even when they have come from a non-goitrous locality.

(5) Goitre is fairly common in middle-aged women in this district. The common type is the adeno-parenchymatous or non-toxic adenoma. Toxic symptoms follow in about 24% of cases and the onset of symptoms takes place on an average eleven years after the first appearance of the goitre.

(6) Exophthalmic goitre is not more frequent than in other districts.

(7) Colloid goitre is not more frequent than in other districts.

(8) Adolescent hyperplastic goitre is not more frequent than in other districts.

(9) The comparatively large incidence in middle-aged women appears to be related in some way to excess of adipose tissue.

(b) Agencies bringing about Goitre.

(1) The iodine intake is deficient.

The diet is deficient in iodine and the water shows practically no iodine. The soil is poor in Iodine,and accordingly fruits and vegetables grown on that soil are correspondingly lacking in that substance.[23]

(2) The diet is deficient in vitamin containing substances.

This tends to make the body more susceptible to any kind of infection, and the particular type of diet under consideration may even be a positive factor in the production of goitre.

(3) Lime plays no part in the incidence of goitre in this area.

(4) It seems clear that infection of the gastro-intestinal tract plays a part. The possible sources are the mouth and teeth, imperfect personal cleanliness, and possibly to a slight extent, infection of the water supply.

(5) It is probable that two factors, infection and iodine deficiency combine to play an important part in the production of goitre in this neighbourhood.

(6) Heredity does not have an important influence in the production of goitre in this locality.

(c) Prophylaxis.

(1) As heredity does not have an influence, the giving of iodised salt during pregnancy does not appear to be called for.

(2) The giving of iodised salt during childhood would be of great benefit. Used for all purposes, a salt containing 1 in 200,000 parts of potassium iodide would be sufficient. This proportion is recommended by the Swiss Coitre Commission.[24] Another method is to give the necessary iodine in the form of cod liver oil, which also contains accessary food factors.

(3) The provision of a generous mixed diet which contains, in part, some of these foods which are rich in iodine, and also fruits, vegetables and milk, cheese and butter. Fish of all kinds and whole oatmeal are also valuable as substitutes for the invariable diet of potatoes and bread. It is most probable that goitre would disappear if the diet were a thoroughly varied one. It is to be feared, however, that this

change would be a matter of some difficulty, for life-long customs die hard.

(4) Improvement of sanitation appears necessary, in particular the substitution of the modern wash-down water closet for the obsolete out-of-door dry closets which, fortunately, are disappearing rapidly.

(5) Improvement of personal hygiene.

With changing conditions of life, improvement in sanitation, and modern teaching in hygiene, the incidence of goitre has diminished of late years, even in those countries where it was formerly endemic, but it is still a source of disability, discomfort, and shortening of life. One hopes that in a few year's time the prevalence will be much less, but perhaps it is too much to hope that the condition will disappear altogether.

REFERENCES.

1. Osler & McRae : Modern Medicine, London 1927

2. Zimmerman : Surgery, Gynaecology and Obstetrics. 1928, XLVII, 497

3. Dunhill : British Journal of Surgery, 1931, XIX., 111

4. Dunhill : Do. XIX., 86

5. McCarrison : British Medical Journal, 1925., 1067.

6. Cobb : Organs of Internal Secretion London, 1917, 75.

7. Marine : John Hopkins Hospital Bulletin, 1907., XVIII., 359.

8. Bourcet : Modern Medicine, London, 1927., 324.

9. McCarrison : British Medical Journal, 1925., 1065.

10. M'Lendon & Hathaway: Journal Amer. Med. Assoc. 1924. 82, 1668.

11. McCarrison : The Simple Goitre, London, 1928, 16.

12. M'Lendon : Physiol. Rev. 1927, VII, 189.

13. McCarrison : The Simple Goitre, London, 1928.

14. McCarrison : British Medical Journal, 1925, 1068.

15. Stocks : Quarterly Journal of Medicine, Jan. 1928, 223.

16. Owen : Geological Maps, Cardiff, 1928.

17. Smeaton : Geological Maps, Cardiff, 1928.

18. F.J.North : Geological Maps, Cardiff, 1928.

19. Annual Report of Urban District of Aberdare, 1925.

20. McCarrison : The Simple Goitre, London, 1928, 54.

21. McCarrison : The Simple Goitre, London, 1928, 21.

22. McCarrison :British Medical Journal, 1931, 3675, 1012.

23. Orr & Leitch : Iodine in Nutrition, London, 1929, 31. (Medical Research Council's Special Report Series No. 123).

24. Orr & Leitch : Iodine in Nutrition, 1929, 81.