An Inquiry into the Caution of Endemic Goitre

being a Graduation Thesis for M.D.
and a Competitive Essay for the Alison Prize in Public Health

James Harrison
20 Church St.
Sunderland, Northumberland
In many limestone districts goitre is absent. Thus in Tibet there are extensive tracts of mountains composed in great measure of limestone but there goitre is unknown.

(St. Gough quoted from Maenamara p. 260)

In Scotland, Ireland and also in Norway many limestone ranges occur yet goitre is rare in these countries.

In the Alps of Styria, Carinthia, Tyrol & Salzburg Haaguet (quoted from Robinson “Endemic Goitre”) found 8 cases out of 2000 or 0.4% of the population inhabiting the mountain limestone affected with goitre whereas, in other formations a large amount of goitre and cretinism was to be met with. In fact in some villages in this neighbourhood the inhabitants, without exception have goitres according to Wylie (quoted in Holmes System of Surgery).

The Valley of Spiti in N.W. India is of calcareous formation and goitre is absent; though it is 2000 feet above the sea. Dr. McGillivray who travelled over the district actually considered that it was to the presence of the limestone that the inhabitants owed their immunity from the disease which is endemic in the neighbouring Valley of Suday composed of gneissoids and other metamorphic rocks. Clearly the limestone was innocuous here.

(Maenamara Jumalayan India p. 392)
Again Goitre is not found endemic on the magnetian limestone of England (Lebour) though the water of such localities is usually very hard. The magnetian limestone prevails all along the coast-line of the North east of England and I questions if any part of this country is free from goitre.

Capt. Gerard says that the water flowing from the hills of Asia forming the Asiatic Side of the Dardanelles is impregnated with lime "yet during a residence of many months I saw no Goitre." (Quoted in Holmes' system of surgery)

Dr. Macnemara says goitre prevails all along the Himalayas without reference to the geological character of the locality." p. 18.

We have thus seen therefore that in many different parts of the world goitre is absent from the limestone. We will now show that goitre may affect those who habitually use a very soft water.

Humboldt (travels in S. America) says that at Maragnuta the springs which flow over granite are chemically pure. than elsewhere yet goitre is worse than along the Magdalen River although there it is endemic to a high degree.
Dr. Thursfield of Shrewsbury who was entrusted with an investigation into an outbreak of goitre in some schools says that the analyst reported the water to be one of the poorest he had ever examined.

In India T. Macnamara made a very exhaustive analysis of the waters of the goitrogenous villages along the Himalayas. He found no relation between goitre and hard water. In some cases the water was hard in others very soft, such as the tank and river water of Coast. He even mentions cases where a water reputed to cure goitre was harder than the water employed to cause it. Thus the goitric inhabitants of the village of Panapur used to leave their own well and resort to that of the Soongong Factory which was said to cure the disease. In Analysis—

Panapur 10.5 gms. Carls of lime 4.1 gms. Carls of Mag. in gill
Soongong 15.5 — 13 —

Thus the curative water actually contained more inorganic salts that that which caused the disease.

Another interesting case is that of Dehra Jail situated in a goitrogenous district. Of 27 persons admitted with goitre, 26 recovered.
in six months, whilst the jail water was very much harder than that used by the town containing 32.4 grs of solids per gall. Thus a very hard water (Maenamara p. 308) This is a case which stands in marked contrast to that of Durham Jail previously mentioned.

Dr Ross (Medical History of the Duffer Expedition) describes an outbreak of goitre among the men at an encampment at the Durning River nearly every man showing an enlargement of the thyroid gland the free only stayed here 13 days. An analysis of the river water, which the free used proved the water to be far from hard viz:-

<table>
<thead>
<tr>
<th>Total Solids</th>
<th>3.04 grs per gall</th>
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</thead>
<tbody>
<tr>
<td>Carbon of Lime</td>
<td>1.02 &quot;</td>
</tr>
<tr>
<td>Carbon of Magn</td>
<td>0.28 &quot;</td>
</tr>
<tr>
<td>Chloride of Iron</td>
<td>0.46 &quot;</td>
</tr>
</tbody>
</table>

At Buna fort the residents developed a goitre after a year's stay yet the water is pure and soft containing only 0.015 grs of solids per 1000 grs of water and only 0.005 grs of Magn (Maenamara p. 220)

Maenamara also gives many instances of goitre developing in people drinking from soft surface springs, whilst those who drank from deep hard wells escaped.
Dr. Mc Clelland in his analysis of the waters of Temasek could show no very marked difference between the goitrous and Sam- goitrous springs except the presence of a larger quantity of carbonic acid gas in the former than in the latter.

Dr. Robinson made an examination of the water of Stanhope in Durham a goitrous district. He found less than 4 grs. of lime salts to the gallon of water, a small quantity.

Dr. Bruce Low mentions two goitrous waters in Helmsley Yorkshire containing only 4.75 and 7 grs. of total solids per gallon.

On a hill side in Allendale in Northumberland I found within a small radius, six cases of goitre all in grown-up persons. The water was reputed to be very soft, as was to be expected, as it was simply rain water which descended through a peat bog, I emerged as springs before it could have travelled any extent of the limestone rock as the houses were all close to the top of the hill.

Therefore from these instances I think it must be admitted that it is by no means necessary to drink a hard drinking water to contract a goitre.
Now Goitre is by no means confined to limestone districts. Thus Prof. Lebour states it is endemic at Crediton in Devonshire and at Wombourne near Wolverhampton yet both these places are on the red sandstone. It also occurs according to the same authority on the lower green sand at Ampthill in Bedfordshire and at Pinxton in the Weald clay and Hastings Sands.

St. Leger also noted its occurrence on the lignite seams beds of France.

St. Maenamara found it very prevalent on the non-calcareous sand and mudbanks of Eastern Bengal and Assam on the laterite and clay soil of the Dacca and from one end to the other of the Peninsular without reference to the geological character of the locality (p. 18).

We have now gone into the limestone theory of the cause of Goitre pretty fully. We have cited many instances showing confirmatory of the view that limestone in some way or other probably by means of drinking water containing an excess of lime-dolomite is the cause of goitre. We have cited several cases strongly opposed to this theory, and therefore
we may now sum up as follows:

1. Goitre is absent in many limestone countries.
2. Goitre occurs in other rocks besides limestone.
3. Goitre may affect those drinking a soft water.

Ergo:—Neither residence in a limestone district or drinking water containing a large quantity of lime shell is in itself the direct or essential cause of endemic Goitre.

Consequently it is high time that this old and erroneous doctrine was removed from our text-books, where it still holds the most prominent position among the alleged causes of goitre.
Malarial Theory of Goitre

This view has lately been coming to the front and implies the existence of some organic poison, variously termed a malaria fungus or germ. We are chiefly indebted to Indian writers for this theory, notably to Macnamara, a summary of whose inquiries it is necessary to give.

He found that almost without exception the most malarial regions in India were at the same time the most goitrogenous. He found that the humour began to increase just after the rains began, just the time when malaria abounds. In fact in some places the people had what might be termed an annual goitre. He also found the disease most intense in low swampy localities where numerous stagnant pools occurred, and where the water supply was highly impure, and often composed of nothing but foul surface drainage, just a likely nidus for an organic poison to thrive in.

The most goitrogenous part of India is the triangle formed by the Gogra, Ganges, and Brahmaputra River. The Himalayas. It is at the same time the most malarious

unhealthy.
He also notes the patchiness of the disease that is its tendency to show itself in localized places, whereas a short distance away it may be totally absent. This patchiness is likewise a characteristic of malaria. He also observes that as the country becomes opened out and cultivated and drained malarial fevers diminish and so does goitre this fact implying of course a similar origin to both diseases. In India he says the belief is general that "as the country is cleared and cultivated goitre disappears."

He gives numerous instances confirming of the malarial origin of goitre. Thus Sir Taylor in his report of Dacca says "Judging from the nature of the localities in which the disease is most frequently met with it would seem it to be rather the effect of malaria than of any cause such as lime in the water" (p. 146). Dr. Maenamar gives numerous other instances of the close connection existing between malaria and goitre. and has undoubtedly made out a strong case in favour of his theory. Many other Indian authorities are of opinion that goitre is due to some specific poison of malarial nature. Thus, Dr. Macdonald writing in the Indian Medical Gazette Nov. 1866, says "The
inhabitants are all more or less liable to malaria, the most remarkable phenomena of which are enlargement of the spleen and goitre. Truly a bold statement to make.

Majn Butler (Travels and Adventures in Assam) says that in the notoriously unhealthy province of Assam, one-third of the population is affected with goitre. "The cause of the disease is principally owing to the rise of stagnant water, and residing in villages which are in the vicinity of extensive marshes."

Sir Joseph Farington inclines to this view—see two letters of his in the Lancet, 1844 on the subject of goathoehel.

Thus in India at all events there seems to be a close connection between goitre and malarious localities, which judging by analogy we would incline to attribute goitre and malaria to a similar cause.

Now let us look at other countries and see if we can find in them any connection between goitre and malaria. The islands of the Malay Archipelago are well known as full of fever, and we find goitre very common in Sumatra, Borneo, and Java (Robinson & St. Leger), the three leading islands...
In Brazil Capt. Burton relates how the people blamed the water of the rivers Jacarezinho and Macucus as causing goitre by the agglutination of vegetable matter a suitable medium for a germ.

In Sardinia, the special commission appointed to consider the question of goitre reported insalubrity of locality as one of the causes of the disease. Now this island is swampy and malarious, being the home of the deadly "infezie" a malarial fever graphically described by Forster (Rambles in Crete and Sardinia).

Piedmont and Lombardy are damp and marshy countries and are full of malarial and goitre.

In the Alps the disease is found in its most intense form in the low deep valleys, so much so that some have considered this fact named low deep valleys as the essential cause of goitre. However it is in precisely such places that we find malarial fens to abound. This is notably so in the Valais. The deepest valley in the world where the soil is full of swamps and marshes at the futter and where the people suffer greatly from goitre and cretinos, fever and skin diseases, particularly in the lower part of the valley the Bas-Valais as it is termed, while higher up...
in the Haute Valais, all these diseases are much less severe, while the marches disappear and the soil becomes much drier.

Fédicke inclined to think that mainly and insalubrious localities had much to do with goitre. (St. Leger p. 69, 1871)

What appears to me to be strong though indirect proof of this view of the etiology of goitre is the frequent association of goitre and cataract with other diseases such as the multiiform varieties of malarial fever, with elephantiasis, epilepsy, cholera, dysentery and parasitic skin affections, all of which we judge from direct observation and from analogy to be due to specific organic poisons or germs. I think this fact indicates that it is in this direction we must look for the direct and immediate cause of goitre.

However, the obvious question now arises—how can we explain the presence of goitre in non-malarious countries such as England. How explain its endemictiy in districts such as my own in West Northumberland, which I have previously referred to as being particularly healthy. How we must not overlook the fact that goitre is a much milder disease in
England than it is in the valleys of the Alps and Himalayas. Consequently, we cannot expect to find the cause of the disease in the circumstances favorable to the development of the disease in so intense a form as it is to be met with in these regions, where of course the disease can be better studied. Let us see if we can find any analogy at all.

My district, as mentioned, is a type of the gothic parts of England and Scotland generally. A vale or valley bounded on high moorland on to each side. Now this moorland abounded with swamps and marshes and stagnant pools. A more suitable spot for the development of malarial fever could not be found. But what prevents it? That all-essential, a high temperature, without which we cannot have the typical malarial fever of tropical climates.

Now the water supply of the people was altogether derived from these moors. The rain water had to soak through the marshy ground percolate through a greater or lesser depth of the limestone rock and then emerge as springs forming the sole water supply of the inhabitants. Now what more suitable middle for an organic poison could be found than these marshy moorland districts? But it may be asked, how is thermal condition we here against the development
I malana, how is it that gohke which you took upon as a disease similar in its origin to gomma. I am not because gohke does not require a high temperature for its development. Thus it is to be met with at Tchubale in Siberia (Encyclopedia Britannica) and also along the Mackenzie River in North America (Sir John Franklin). It is as Maenanara nearly put it: "a mild form of malaria."

I found gohke most prevalent along that side of the valley where the adjacent moorland contained the most swampy ground. In fact at one point where the disease was specially common, the water supply descended from a stagnant pool through only a very short depth of ground as was clearly shown by the fact that in dry weather the spring soon diminished in volume. Now this I repeat is a typical example of the gohke-ridden parts of England and I think we can have a resemblance, though perhaps not in some cases well marked, to those regions where gohke is to be met with in its most virulent form namely the Valleys of the Alps and Himalayas.

Another argument in favour of this theory of the etiology of gohke is the existence of what is known as "Weaver's gohke"
A disease to which a scanty reference is made in most of our textbooks, is invariably ascribed to the emanations from steeped flack, which is simply decomposing organic matter, an excellent nidus for a malarial germ. Thus at Jocca in India, the presence of the pots containing the steeping flack is considered to aggravate the malarial character of the country (Maenamer, 145).

The epidemics of grube which have been recorded seem to my mind to afford confirmation to this view. Epidemics have occurred in schools at Autumn (st. Peter) in England (Didcotfield) in garrisons such as Amnay in France (st. Peter) in jails, as Durham (Johnson). These bear a striking resemblance to those of typhoid and other specific diseases indicating a similar origin, probably if the grubies poison finds access to the water supply, some means for other.

A long ago as 1861, Dr. Zilius published a work on the malarious origin of the idiocy and grube in the neighborhood of Salzburg, in which he gives strong indications in favour of the malarial nature of the disease, showing that fever sometimes accompanied the disease (Med. Chir. Revew 1861 Vol. I).
St. Leger, even, seems unnecessarily to have adopted the view of a specific germ as a cause of goitre. Biological experience then has proved that certain waters are goitrogenous just as it has shown that it suffices to tincture the air of marshes to contract fever although we chemistry has been able to seize upon the principle of malaria, much less typhus, cholera, yellow fever and the plague. It thus associates all these specific fevers together.

Now I am well aware of the objections which can be raised to the theory of the malarial origin of goitre. Thus goitre is to be met with where none of these conditions commonly associated with malaria occur such as marshy, damp soil. Let us take, for instance, malaria often occurs in barren sterile, districts (Grain: Dict. of Med. Article Malaria). On the other hand there are many marshy malarious districts where goitre is absent, e.g., Mantua in Italy (St. Leger), Poona in India (Menamur Etc.). But this is no argument against this theory as the same holds good for every other disease. We need only go into the slums of our great cities to find all the apparent conditions requisite for the development of typhoid, yet the disease may not be present.
It is also curious that, outside of Iodine, that eliminator of poisons, should be so effective in dissolving a goitre, as I have often noted.

Iodine has also been successfully employed in Dublin.

There are of course only order in passing, but I think that as far as our present knowledge of goitre goes, it is to a specific organic germ of malarial nature that we must look for the cause of goitre. The disease, as all the other theories which have anything to back them up, we have I think conclusively shown to be erroneous, even the favourite view of water impregnated with lime salts.

The idea of a specific poison of malarial nature as the true cause of goitre is held by many eminent writers including Virchow, Billroth, Trebel, and Modell, and the able author of the articles "Goitre" and "Carcinoma" in the new edition of the Encyclopaedia Britannica seems also to lean to this view.

In such company we will not go far astray in considering Endemic Goitre to be a disease owning as its cause a specific poison, which as far as we can judge is of malarial nature though certainly not the identical Bacillus Malanee of Klebs and Tommasi.
Now by way of an appendix, I would venture to suggest an explanation of the undeniable tendency of goitre to affect limestone districts.

Is there any peculiarity in the water of such districts besides hardness, which we have shown is not the cause of goitre? There is one point worthy of note: that is, that such water always contains dissolved in it a large quantity of Carbonic Acid gas. Now I consider that we are warranted in assuming that this gas is favorable to the existence of goitrous poison and for the following reason.

It has been observed that a goitrogenous water, when conveyed any considerable distance from its original source seems to lose more of its noxious properties.

Dr. St. Leger says (Vol. 2, p. 111):—

"It is remarkable that waters which produce goitre near their source should lose almost entirely their bad quality after a course of 5 kilomètres. I have had occasion to mention similar facts in Auvergne. The goitrogenous quality of the water of Royat is considerably weakened when it arrive at the public fountains of Clermont-Ferrand."
It is the same at Reno whose public fountains are fed by the springs of St. Genevieve which are in the highest degree fortuitous at their emergence.

Now we know that a spring-water always contains its maximum of carbonic acid near its source, the gas gradually becoming dissipated as the stream flows onward.

Now assuming the existence of a specific germ we can easily see how if this gas is favorable to its existence and development, that as the gas is lost the germ becomes more or a greater or less extent.

Another remarkable instance is the case of the Saskatchewan River where goitre is so common. Sir John Franklin (Journey to the Polar seas) describes goitre as being highly endemic at Fort Edmonton on that river, but states that at Rocky Mountain House sixty miles nearer the source of the river goitre is even more common. So whereas noti well — further down the river below Fort Edmonton at Carlton House the disease is known only by name. At this point the river becomes turbid and milky, now what causes this turbidity, clearly the escape of the carbonic acid which leads to the deposition of the lime salts causing turbidity.
Here the water of the river was certainly the cause of the disease as it did not affect those using other waters.

In the case I mentioned of M. R. and his wife developing gothie on a change of water, the spring they blamed as the cause of the disease came out of the ground with strong ebullition of Carbone acid gas.

St. Leger states that in the country which extends at the foot of the Alps towards Neuwied and Coblenz there are more than a thousand springs charged with Carbone acid, and that this country is a hot-bed of gothie.

Mr. Clelland found in all the gothie springs which he examined a much larger proportion of Carbone acid than in the non-gothis springs, and seems to attach some importance to the presence of this gas.

Should then this gas favour the development of the poison of gothie we can readily understand how the disease affects certain districts. This idea is however a mere conjecture and I only mention it for what it is worth.
Wicks and Aitken referred to in connexion with the "Inquiry into the Causation of Endemic Goitre."

Aitken
Science & Practice of Medicine
Theory & Practice of Medicine
Principles & Practice of Medicine

Robert

Sir Thomas Basting
Science & Art of Surgery

Buchanan

Endemic Goitre

Buchsen

"Etudes sur les Causes du Oedème et du goître endémique." (Paris Ballière et fils. 1869)

Holmes

Himalayan India. Climate & Diseases. 1858

Robinson

Dictionary of Medical Arts. Goitre & Allied Geographical Distribution of Goitre in England

St. Leger

"The Highlands of Brazil."

Maenamar

Lebon

Oxford

Beck, Burk

Encyclopaedia

To Cledland

Stevan

Woolocks

Brannley

Brenchetle in Nepant (Trans. of the Med and Phys. Soc. of Calcutta 1839)

Wilson


Inglis

Goitre in British Journal of Medicine 1886 (Sept.)

Smith

Thomson


Thomson

Central African Lakes.

Ewingstone

Last Journal.

Forester

Rambles in Spain. & Sardinia.
Livingstone, "Last Journal"
Forrest II, Rambles in Ceylon & Scandinavia
Capt. Cook's Voyages
Johnson, Water Supply of Durham Jail
(Edin. Med. Journal May 1855)
Christie, Report on Manchuria
Janeet, Aug 25th 1853
Humboldt, Travels in South America
Sir John Franklin, Journey to the Polar Seas
Ringer, Therapeutics
Macdonald, Indian Med. Gazette, Nov 1866
Major Butler, Travels and Adventures in Assam
Zillner, On the Malarious Origin of the guine and shote of Salisbury
For a considerable space of time it fell to my lot to be located in the district of Allendale in the West of Northumberland where Goitre is endemic in a high degree.

A great number of cases came under my observation hence my attention was naturally directed to the "raison d'être" of this curious disease.

Why, I asked myself, should this unrightfully malady occur in a locality like this perhaps one of the healthiest in all Britain?

Imagine a picturesque valley or dale running from 1300 to 1700 feet above sea level, said to be the highest inhabited district in England, without a colliery or factory of any kind to pollute the air with noxious fumes where the fine clear atmosphere is a balm in itself, and you will not wonder that I became curious as to the causation of endemic goître.

I proceeded to dip into the literature of the subject first in general textbooks next in special treatises on the subject. I found the diversity of opinion on the etiology of the disease to be something extraordinary. Dr. St. Sages the leading authority devoting several pages of his work to a mere list of the various theories advanced by different writers.
Now for the sake of completeness it is
necessary to give some idea of the
grotty LA District in which I resided,
as I will frequently refer to my own
observations in discussing the various
views held regarding the causation of
the disease.

The district of Allendale is situated
in the extreme South-western corner of
Northumberland, just on the borders of
Durham and Cumberland. It comprises
a valley or dale with a stream running
along the bottom joined by smaller streams
meandering down the hill sides. The
valley is bounded on each side by wild
mountainous moorland containing many
swampy patches and numerous peat-bogs.
Geologically the district belongs to the
Carboniferous limestone formation and
contains many valuable lead veins.
Sulphur and iron springs are found
here and there. The water supply is
abundant and is derived from springs
bubbling out of the hill sides, each house
possessing its own spring.

As regards the land it is entirely
employed for raising cattle, being all
pasture land, no wheat, barley, oats or
being grown. The inhabitants are in
strength and physique decidedly above the average. The amount of sickness is slight. The people hold little communication with the outside world, which explains the tendency to intermarriage which undoubtedly exists.

After this brief sketch of the locality, which I may mention by the way is a type of most of the gipsyish parts of England I will proceed to an equally brief account of the goitre I saw here before going into the subject in detail.

It was some time before I discovered that the disease was endemic in this district, it being actually so common that the inhabitants rarely thought of complaining of it unless the tumour reached unusual dimensions. However, when I made inquiries I discovered a great many cases, most of the growths reaching the size of a small orange, but sometimes growing, attaining a much larger size, whereas in other cases only a slight fullness at the base of the neck was to be observed. The disease was locally known by the name of "thickenk" and contrary to the usual rule I found it nearly as common in men as women although in nearly all goipsyish countries women are most frequently affected in the proportion according to Sir Thomas Watkin's Analysis of 12 to 1.
Gobbe is said to generally make its appearance about the time of puberty. I found it to begin at almost any age, and a man came to me with a greatly enlarged thyroid of only two months duration, yet he was 50 years of age and had resided in the district all his life. Clearly, we must take into consideration the fact that we must have besides the direct and immediate cause of the disease, the system of the patient brought into a state suitable for its reception and development, before the enlargement of the gland will begin. Else how can we explain the fact that among people living under exactly similar conditions, some are affected while others escape.

Cretinism I found to be absent, though I found one idiot with a gobbe but he was most certainly not a cretin. However, I agree with the common view that both diseases own the same cause. We find them too often associated to deny the connection which exists between them. The most modern investigations into our disease all point to this one conclusion that as Maffei neatly puts it: "Gobbe is the beginning of that degeneration of which Cretinism is the end." We must assume that here the poison was not sufficiently intense.
to produce the more virulent form of the disease.

I collected notes of a great many cases to which I will refer under various heads.

Goitre is defined in the official nomenclature of the Royal College of Physicians as “Enlargement of the thyroid gland endemic in certain mountainous districts but not limited to them.”

It is a disease known by many other names: Bronchocele, Thyrocele, Thyrophrenia and locally as Derbyshire Neck, Clydesdale neck, West country neck, Thick-neck, Nithsdale Neck.

Space forbids me to go into the morbid anatomy of the disease, sufficient to say that the tumour may pass through the various stages of congestion and fluid fibrous hypertrophy to cystic or calcareous degeneration.

Goitre may truly be said to be universal in its distribution, as race or country being entirely exempt from it; but in certain localities it is so common as to be termed endemic, although this fact has been disputed and by no less an authority than Dr. Woakes.

He says in an article on the “Pathogeny and Treatment of Goitre” (Lancet March 1881) that it is not easy to name a district where goitre is unknown, and therefore
states that he disbelieves the theory of the endemias of the disease, being rather inclined to look upon it as due to a pass-motor paroxysm of the inferior hypoglossal acting.

Undoubtedly the disease is more widely distributed than we are aware of. But still it is likely, we must assume, that never lived in a godfrequented locality or he would not have advanced such a statement, in the face of observations made in different parts of the world by hosts of writers both professional and lay. Note the quotation:

"Quis lüridum gullet miratur in Alpibus?" says Juvenal. (Encyclopedia Britannica, last edition, article Goethe and Cetheinem.)

Now before inquiring into the cause of this strange malady we must investigate its distribution in order that we may contrast the surroundings of one godfrequented district with those of another. I will therefore give a short account of the chief godfrequented parts of the world compiled from different sources, and while I do not claim that this summary is complete, the difficulty of getting exact information being very great, I maintain that this list taken in conjunction with the accompanying map will give a fair idea of the distribution of Endemie Goethe.
Distribution of Endemic Goitre.  
Original Regions. Red.
England.
Very common in the districts along each side of the Pennine Range, viz.:—Western parts of Northumberland, Durham, Yorkshire, Eastern parts of Cumberland, Westmorland, Lancashire, Cheshire. In Derbyshire "Derbyshire Neck" particularly at its northern end, where Stone Middleton is situated, the most goitrous place in England. In Nottingham, in Helmsley in N.E. Yorkshire. Common in Malvern, Forest of Dean, Bristol, North, Sussex (parts), Ampthill in Bedfordshire, Timbridge Wells, Spledhurst, Hastings, Horsham, Pontecraft, Ripon, Crediton in Devon, Wombourne near Wolverhampton. Occasional in Surrey, Newhaven, Hampshire, Dorset, New Forest, Buckingham, and Monmouth. St. Staffordshire.

Scotland.
Ireland; early met with (Quain Decr. Med)
Continent, Switzerland might well be termed the home of gouty go common is the disease especially in the deep valleys of the Alps France contains it is said 450,000 goutous inhabitants (Dr. Bruce Roy. "On the Etiology of Endemic Goitre" Brit. Med. Assoc. 1882). The Western parts of France are most affected notably the districts along the Jure river and Savoy, Oyon-de-monts and Dauphine and the neighborhood of the Cevennes Mountains Spain chiefly in the Pyrenees. Germany, worst about the Black Forest Wurtemburg. Dresden, Strasbourg, Colmar. Austria mostly in the mountains of Styria, Tyrol and Carinthia also in Vienna and Bavaria. Very bad at Salzburg Italy, most abundant in the North especially in Piedmont and Lombardy where a special commission was appointed to enquire into the subject. Also in the valleys of the Apenines Turkey particularly in Bosnia Russia, most abundant about the Altai Mountains. Sardinia, gout is here very prevalent so much so that a special commission was also appointed to investigate the cause of the disease.
Asia

India, extremely common in the Himalayan and Sub-Himalayan regions and most intense according to Marenara in the triangular area formed by the Eastern Himalayas as a base and the rivers Gogra, Ganges and Brahmaputra as the sides.
In the states of Assam and Nepal it is also very common, also in tribute in the western parts of Siberia and about Irsutok.

In West China and Tartary, in the Kwang-Tung mountains and in the hill country to the west of Manchuria.
In Borneo, Sumatra, and Java, it also occurs.
In Eastern Turkestan about Kashgar and Lake Tso.
(Pellworm in Kashmir & Kashgar Jaubner 5 C.)

Africa

In Barbary. Algiers El Mungo Park mentions in his later book of travels in the Atlas mountains it is also found.
In Central Africa Livingstone records meeting cases among the hill tribes of the Lopere and Kebri district.
In the Sahara desert, it is said to be found in the oases. In Abyssinia, according to McClelland Thompson in his Central African Lakes stated that cases are frequent on the west side of Lake Tanganyika.
In the United States, Goitre is met with, according to Aitken (Medicine) in New York State, New Hampshire, Virginia about the Blue Ridge Mountains, Pennsylvania, and Vermont.

In British North America, Sir John Franklin & Sir Richardson note its extreme prevalence along the Saskatchewan River particularly at Fort Edmonton and Rocky Mountain House (Journey to the Polar Sea).

According to the Encyclop. Britann. it is also found at the Mouth of the St. Lawrence. In Central America it is found in Mexico, Guatemala, de San Salvador, Nicaragua, and Costa Rica (St. Leger Vol. II. p. 83).

In South America, it extends the whole length of the Andes reaching to Patagonia. In Peru it is said to be the only endemic (Enc. Brit.)

In Brazil it is exceedingly common as is recorded so long ago as 1826 by Spix and Martius (Travels in Brazil) and more recently by the celebrated traveller Capt. Burton in his work (The Highlands of Brazil) and along the R.

In Columbia, the most northern State of South America Humboldt (Travels in S. America) found it prevalent along the Magdalena River and in the high Tableland of Bogotá and at Maraguchá.
After this sketch of the distribution of Endemic Goitre we will proceed to discuss the various theories which have been advanced from time to time as to the cause of this remarkable disease, eliminating each theory in turn after a fair statement of the "pros and cons" and thus narrowing down the inquiry to what I consider the most rational view to take of the etiology of goitre.

Connection with Heredity.

Some look upon Goitre as an hereditary disease. There is much to be said both for and against this theory. Children have often been born with Goitre. Dr. St. Leger records many instances of this in France and Switzerland. (Etudes sur les causes du cœlitisme et du goître endémique. Paris: Ballière et Fils 1867)

Dr. Robinson says he met with 3 cases in his own practice in Stanhope in the County of Durham. (Endemic Goitre. Churchill 1885)

Mr. Bramley says congenital goitre is common in the native Kingdom of Nepal in India. (Bemiehreele in Nepal. Trans. of the Med. and Physical Soc. of Calcutta 1883)

Dr. Maenamara mentions many cases in various parts of India (Himalayan India II: Climate and Diseases Longmans 1880)
Dr. Bruce Loe who has gone into the subject of goitre very fully (v. his articles in the British Medical Journal Jan 14th & 21st 1882) in a letter to me of Nov 28th 1883 informs me that he came across 3 cases while resident in the goitrogenous district of Helmsley in Yorkshire. In some of these congenital cases the parents were goitrous in others not so.

Dr. Throsfield in a paper read before the Society of Medical Officers of Health May 10th 1885 on the "Etiology of Goitre in England" says "Goitre has a most decided hereditary tendency. I have seen many such cases both direct and collateral."

Dr. Sloan (Endemic goitre in Wishaw Edin. Med. Journal July 1883) found hereditary tendency in 8 out of 12 cases which he examined.

At first sight congenital goitre might seem a strong proof of heredity as a cause of the disease. But we must not overlook the fact that the foetus in utero is exposed to the endemic influence equally with the mother as is shown in many cases of goitred children born to healthy parents recorded. Before we can entertain the notion of heredity as a cause of goitre we must find authentic cases of goitrous children born to goitrous parents but in non-goitrous districts. Instances of this are difficult to find.
There is the oft quoted case mentioned by Ingalls (English Bronchocle 1838) of certain French prisoners in England formed connections with the women in the neighborhood and it is said that the female part of their offspring were goitric. The men were supposed to be from a goitrogenous part of France.

A case in point came under my own notice recently in the town of Salt Shields at the mouth of the Tyne where goiter is unknown. I was consulted by a patient from a goitrogenous district of West Northumberland with a goiter of many years standing. She showed me her daughter born and bred in this town who presented a distinct fullness at the base of the neck evidently an incipient goiter. It is interesting to note in passing that this is a magnesian limestone district and that the water is extremely hard. I may have occasion to refer to this case under another heading. But in congenital goiter the influence of locality is beyond doubt all important, as is shown by Dr. St. Leger. He gives many instances of women leaving goitrous districts such as the Valais to spend the period of their pregnancy in a healthy locality that their children might escape this hideous deformity.
Again many instances are known of women the mothers of healthy children who on coming to an affected district gave birth to cretins or goitred children. Dr. Coates quoted J. Macnamara p. 249 found 1197 goitres with 2714 unaffected brothers and sisters, all born of goitred parents; thus according to these statistics affected parents produce more healthy than goitred children.

In the notes of cases made by me in West-Northumberland I find the great-majority of cases were born to healthy parents. From a consideration of these facts, I think we may conclude that heredity has little or no influence in the causation of endemic goitre.
Connection with Intermarriage and Consanguinity

Many consider that too close intermarriage predisposes to goitre. Undoubtedly in many instances goitre shows a tendency to affect but of the way localities where there is little introduction of new blood and therefore a lesser liability to intermarriage. The old-fashioned habits of the inhabitants of the Alpine Valleys is well-known, and they may almost entirely among themselves. In my own district, there is undoubtedly far too much intermarriage. Carl Rusten (Highlands of Brazil) speaking of the Minasio mountains where goitre is very prevalent states that the people intermarry to a large extent.

Dr. Guggenhilt the founder of the Retin Hospital on the Abendberg Mountain considers intermarriage a contributory cause of goitre and Cretinism (Sohmer System of Surgery).

It is somewhat interesting to note that breeding "in and in" that is to closely in cattle causes goitre. (Dr. Bruce Low)

However, there are lots of goitreous places where intermarriage prevails, does not prevail. Consequently, we must conclude that intermarriage has nothing to do with goitre except in so far, as it may lower the stamina of the race and render a people more liable to the influence of the goitreous poison.
Connection with Atmospheric Conditions.

All sorts of air have been credited with causing grie.

Stagnation of the air was blamed for rashes as the cause of the disease in the steep valleys of the Alps and Pyrenees (Encyclop. Brit.)

In my own district the air was free from stagnant gales of wind, being of frequent occurrence, ventilation being of anything too brisk.

In Arvon where grie abounds the air is very still, it is exactly the same in Berham where no grie occurs (Maaanamaa).

Acting on the theory of a stagnant atmosphere the Sardinian commission advised trees to be cut down in affected localities, yet, to allow free ventilation, yet in my own district the farmers actually planted trees to prevent the cattle from the violence of the wind.

The rarefied air of mountains has been blamed equally with the dense air of deep valleys.

Dr. Bumsfield lays special stress on the influence of mountain air.

Air hot and cold, moist and dry, all have had the credit attached to them of causing grie.

Yet merely a glance at the distribution of the disease must convince anyone that air in itself has certainly nothing whatever to do with the causation of so wide-spread a disease as Endemic Grie.
Connection with Increased Vascular Pressure

It is conceded that anything which causes an increased flow of blood towards the brain will tend to produce goitre. They consider this vascular and dilatation gland to serve as a diuresis to the cerebral circulation when it is pressurised. Hence, has originated the theory that carrying weights upon the head will help to cause goitre. Dr. Thursfield says this is "a most potent and contributing cause" in mentioning one locality where goitre has greatly decreased once the custom was given up.

Dr. Wilson writing in the Indian Annals of Medicine Vol XXXII made an investigation into the goitre of Bagana, a hill station of the Pungarbhore found it worst among the cultivating population and ascribes this to their custom of carrying weights upon their heads.

Unfortunately for this theory corroborative evidence is wanting, while hosts of arguments can be brought against it. Thus still after the publication of Dr. Thursfield's letter paper, a letter appeared in the British Medical Journal from Dr. Josiah Smith giving an account of the extreme prevalence of goitre in certain parts of Turkey through which he had travelled and stating distinctly that the people were by no means in the habit of carrying heavy loads upon the head. In my own district the people
Certain did not carry weights upon their heads. Capt. Bustin says this theory will not hold good on the highly goiterous districts of Brazil which he visited.
The same applies to many other goiterous districts.
In this connection I may mention an interesting case which came under the notice of F. Girvan a neighboring practitioner. He came across six cases on board the Wellesley, a training ship for boys lying in the River Tyne. Curiously enough these boys were all in the band, and he offers the very plausible explanation that the increased vascular pressure on the vessels of the neck caused by playing wind instruments produced congestion and hypertrophy of the thyroid. It would be instructive to ascertain if any similar cases had been observed in other bands.
I mention this case in passing, but it would be exceedingly interesting if this theory of increased vascular pressure might be applied to those cases of sporadic goitre which crop up every now and then in non-goiterous districts.
My own observations are however totally opposed to the idea of carrying heavy loads upon the head, or any other form of increased pressure upon the thyroid, having anything to do with the causation of Endemic Goitre, whatever effect it may have upon an isolated case here and there.
Missive, Theory of the Causation of Goitre.

I bring under this head, alleged causes which space forbids me to discuss, and the majority of which are merely worthy of mention.

Want of Electricity in the Air (Ephesians)

Goitre a Variety of Scofula

I have seen it in the Healthiest and stoutest men, and Dr. Bruce Low says the same.

Excessive sexual Intercourse (Spit & Markhus)

I blame this as the cause of the goitre of Brazil (Travels in Brazil 1828 quoted J. D. Bruce Low)

Exposure of the neck to the air

Intemperance of parents at time of conception?

Various conditions of the Sexual Organs.

(Loan, Lawrie Talbot, Edin Med Journ May 1846 etc.)
Connection with High Altitudes

Gout is beyond all doubt has a distinct affinity for hilly districts which some look upon as the main factor in the production of the disease. Glance at the distribution of the disease. We find it very prevalent in the great mountain ranges of the world. The Alps, Andes, Himalayas, Rocky Mountains, Apennines, Atlas Mts. Atlas Mts. Pyrenees

Even in England this fact can be noted. We find gout the most intense along the Pennine chain of Mountains, the highest part of England. The district where I lived, the highest inhabited district in England ran up to 1725 feet above sea level. Derbyshire which has given a name to the disease is a hilly county running up to 1300 feet at its Northern end, and it is interesting to note that it is at this northern and highest part that gout is most abundant.

Both Livingstone and Thompson note its occurrence among tribes inhabiting mountainous regions in Central Africa. Capt. Burton found it very common in his travels in the "highlands" of Brazil.

A suggestive note in this connection appeared in the Lancet Aug. 25th 1888, in the report of Mr. D. Christie, United Presbyterian missionary in Manchuria, China.
He states that in Manchuria goitre is occasionally met with but N.B. is endemic in the "hill" country further east.

Humboldt the great Traveller noted the disease on the high table-land of Bogota in Columbia, S. America, 6000 feet above sea level. It occurs on the high Peruvian Plateau of cases according to the able writer on Goitre in the (En. Brit). Goitre is extremely common in Nepal a mountainous country of Northern India.

Even in Shakespeare's time the connection between goitre and hilly districts had been noted. How else can we explain the quotation:—

"Who could believe that there were mountaineers" Dow-lapped like hills whose throats had hanging at them "Wallets of flesh." (Tempest Act III, Scene 3.)

These facts are I think sufficient to show that goitre exhibits a marked partiality for hilly districts. Note the definition of goitre by the Royal College of Physicians as an endemic disease. Common in certain mountainous countries.

Dr. Thursfield in the paper already quoted lays great stress upon the influence of high altitude in the production of the disease. He considers that in England at all events goitre will not be found at a less altitude than is indicated by a fall in the column of Mercury equal to three-quarters of an inch.
However, I have no hesitation in saying that high altitude is the essential cause of goitre. Thus it is met with in its most frequent forms in some of the low-lying valleys of Switzerland, such as the Valais. It seems extending to Macanunara as many of the low-lying plains of Bengal. It is found on the plains of Alsace and Lombardy, according to the Oeygolo. Britain. It has also been found on the sea-shore of the Isle of Arran (St. Leger) and at Viborg and the Mouth of the St. Lawrence, and even at sea. Thus what might be termed an epidemic of goitre occurred on board Capt. Cook's ship miles away from land. (His Voyages.) Cases have occurred also on board the Wellesley Training ship lying in the river Tyne. Particulars of which have been kindly furnished to me by Dr. Govans, a neighbouring practitioner. The Honorary Medical officer to the vessel to which I refer under another head. Dr. Guggenbühl, the founder of the Cretin Hospital on the Altenberg, says he has seen many cases improve on removal to a higher elevation (Holmes' system of Surgery Art. Goitre). I might mention many other cases of the same effect, but I think the above are amply sufficient to show that high altitude is not in itself any potent factor in the production of endemic goitre.
Thus gothic is not found at least not to any extent on the Rampian Hills of Scotland though much higher than their English neighbours of the Pennine Chain. Again it is absent in Thibet one of the highest countries in the world.

Of course the underlying idea of the influence of high altitude, is that the diminished atmospheric pressure in hilly districts acting on the natural distensible property of the thyroid, will cause it to expand & lead to hyperthyroid of the gland.

Therefore we may sum up, that though gothic shows a preference for mountainous regions yet it is not to the mere elevation that we can ascribe this fact, but there may be other reasons to which we will allude later on.
Connection with Drinking Water

The belief that water is the medium by which the poison of goitre, whatever it may be, is conveyed like the disease itself, and has come down to us through centuries. Many of the ancient classical writers support this view. Hippocrates, Aristotle, Celsius, Pliny, etc. And it is still held by the majority of modern writers on the subject. The evidence in its favour is overwhelming. I will give a few instances drawn from widely separated localities.

In France there are what are termed goitreous springs, thus St. Leger mentions how men anchored to avoid the contrary used to resort to the springs of Briancenon, Clemont, Ferrand, etc. to drink the waters there, which often produced a goitre in a month. Goitre exempt from military service in France. Hence the attention which has been directed to the disease in that country.

In Vienna goitre is on the increase, a fact ascertained by Billroth to the water supply being now derived from Styria, a goitrogenous locality.

In India Melville's observations are most remarkable. In his book "Sketch of the Medical Topography of Bengal & W. Bornees"
Take the two villages of Beechelly and Reunna. The former with nearly half its population affected the latter with only one case in its population of fifty. Yet these two villages are within a mile of each other and correspond in all particulars except that the water supply of the former is derived from springs, the latter from the river.

McClelland gives many other examples, too numerous to mention.

Durham. A striking example is recorded by Dr. Johnson in the Edin. Monthly Journal (May 1855). An outbreak occurred among the prisoners in Durham Jail, and the water being suspected, an analysis was made of it. Being found very impure, a new supply was laid on by the Durham Water Company, and as a result the goitre rapidly disappeared although no other change in the mode of life of the prisoners was made.

Many instances are related of goitre being caused or cured by a change of drinking water. A case which came under my own notice will serve as well as any.

Mr. R., a middle-aged, healthy man occupying an outlying farm in West-Northumberland. Both he and his wife are goitrous, and bred and born in this goitrous locality. He informs me that up
Is a couple of years ago, they were free from the disease. At that time they derived their water supply from a spring near their house, but the supply diminishing they changed to a spring which came bubbling out with effervescence out of the hill side a little distance away. In two months, both became goitrous. A stronger instance than this of the influence of water in the production of goitre it would be difficult to find. Here were two people living in the same house under precisely similar circumstances all the time yet both develop goitre after a change of water. Many other instances might be given. Thus Sir John Franklin states that at Edmonton on the Saskatchewan the inhabitants who use the river water are largely affected with goitre while those who drink from other sources escape. Dr. Coindet says that the use of the hard pump water of Geneva will soon cause a goitre.

Surely these instances are sufficient to show that certain kinds of drinking water stand in a causative relation to goitre. The natives of goitrous countries almost invariably blame the water. This is the case in Barbary, India, Nepal, Brazil, France, etc.
So far in our inquiry into the causation of goitre we thus seem to be moving in the right direction when we conclude that drinking water is the vehicle by which the cause of goitre whatever it may be reaches (reaches) our bodies, but when we inquire what the active agent is we are again in the region of speculation, the diversity of opinion being as great on this subject as on the theories we have already considered.

Let us discuss the main views which have been advanced from time to time on this point,

Snow Water, Ice Water, Cold Water.

All these have been blamed as the exciting cause of goitre chiefly Goutiers who have limited their observations to Switzerland, had they looked a little further afield, they would never have advanced such a theory.

In the neighbourhood of Calcutta, cold water is not likely to be abundant, still less so in the Sahara desert, yet in both these places goitre is to be met with.

Hippocrates, Aristotle, Galen and Celsus all inclined to this view, but we must remember that they were ignorant of the wide-spread area in which the disease affects. Clearly a knowledge of the distribution of a disease is all-important in
Considering its causation. Some colour was lent the theory of snow-water in more modern times by an outbreak of goitre on board Capt. Cook's ship among a part of his crew who drank water from an iceberg, while those who used the ordinary ship's supply escaped. But these are hosts of arguments to show that snow or ice-water can have nothing to do with the disease, thus Athen says it is unknown in Greenland and Lapland, where snow and ice are found all the year round, yet it is common in Sumatra, where snow is never seen. A case well worth mentioning in this connection is recorded by Macnamara. Sir Cayley who resided two years in Thibet says: “In Ladak and other parts of the highlands of Thibet goitre is virtually unknown, the people drink almost exclusively snow and glacier water from streams which come direct from the snow.” Capt. Franklin states that at Edmonton, where goitre is very prevalent, states that those who drank snow-water escaped. Surely instances such as these, together with the fact of the occurrence of the disease within the torrid zone, must nullify any arguments that can be possibly brought forward in favour of the snow-water theory.
Connection with Iron Salts.

It has often been maintained that drinking water containing iron salts is the cause of goitre. St. Leger has invariably been brought forward as a witness to this doctrine. His researches being what might truly be termed the cornerstone of this theory. He did indeed consider that the presence of iron pyrites had much to do with goitre and thought that in some instances he produced enlargement of the thyroid in mice by adding sulphide of iron to their food. He admits that his experiments were unsatisfactory.

Certainly ferruginous springs are common enough in most of the goitrogenous parts of England. Thus D. Bruce Low of the Local Government Board in his analysis of some of the goitrous waters of Helmsley found a very appreciable quantity of iron present in every instance which he examined.

D. Robinson found iron present in the drinking waters of both Stanhope and Rookhope in Durham both goitrogenous districts. I have myself seen goitre develop in a family who derived their water supply from a spring strongly ferruginous.

D. Macnamara p. 183, mentions the goitrogenous district of Durring and says that the soil is very ferruginous, though no lime occurs in the neighborhood.
Dr. Tweedfield attaches great importance to the presence of iron in drinking water as a factor in the production of goitre. He considers that iron pyrites which is so often present in goitrogenous localities, though itself an insoluble salt yet meeting carbonate of lime and magnesia in carbonic acid solution will by a process of oxidation become changed into the soluble carbonate of iron, the most assimilable of all the iron salts, (Anzer Feruphatic) and thus readily pass into the system.

Now he looks upon the thyroid as concerned in the excretion of these blood corpuscles, and that therefore this continual ingestion of iron will of course cause increase the amount of work performed by the gland and consequently lead to its hypertrophy. This theory is ingenious but erroneous. The latest views of physiologists regarding the thyroid founded on the researches and experiments of Kocher and Hartley, is to class it with the nervous system rather than with the blood forming glands; thus Professor Rutherford in a letter to me of December 38 kindly informs me that the latest most recent investigations point to the thyroid as having some important function in helping the nutrition of the nervous system muscles and various other tissues. "It is conjectured that it does this by producing some substance of service in their nutrition."
 Besides this there are many other objections to the iron theory. Macnamara mentions a case well worth noticing in this connection. In Chimni, a town of Northern India, there is a good deal of goitre. The town possesses a well reputed to cure the disease, yet it comes off a red sandstone highly impregnated with iron and Dr. Deane the Civil Surgeon says there is no goitre amongst the inhabitants who drink this water although it is common enough in the other parts of the town.

Prof. Lebour of the Durham College of Science gives an amusing instance of the diversity of opinion regarding the influence of iron upon the thyroid. Dr. Moffat of Hawarden, he says, considers that goitre cases improve when removed to the near red sandstone on account of the presence of iron whereas Dr. Ballard reported to the Local Government Board that he considered that the goitre of Wombourne near Wolverhampton was due to the presence of iron in the drinking water.

Again it is very difficult to understand how it is that goitres often diminish under the administration of iron, if this metal has anything to do with the cause of the disease. In fact goitre cases are often anaemic, a fact upon which Mr. Ezechien lays special stress but the greatest downfall to those who hold to the iron theory comes from Dr. Lager himself, Dr. Robinson of Stanhope kindly informs me that-
St. LAGER in a letter to him of May 1859 says: "Je vous aurais appris que par des expériences faites ultérieurement (c.e. 1868) sur des animaux, j'ai acquis la preuve, que le soufre de fer n'est pas la cause directe de goître."

Thus when St. Lager himself renounces this theory, it is scarcely worth while to discuss the question of iron salts further, as almost all the arguments in its favour have been drawn from his researches. I therefore think that from the foregoing account we must conclude that iron has nothing whatever to do with the production of goitre.
Connection with Limestones.

Now come to the favourite view held by the great majority of writers ancient and modern that water derived from limestone strata and containing an excess of limestone is the cause of goitre. As this is the view accepted even at the present time, and which occupies a prominent place in our most modern textbooks I purpose discussing it in some detail.

Now it is well known that goitre is very common in limestone districts. Hence the idea that the waters of such districts which usually contain a large quantity of the salts of lime and magnesia is the active agent in the causation of goitre.

In a great many countries where the mountain or alpine limestone abounds, goitre is endemic. This is the case in the Alps, Pyrenees, in Dauphiny and the west of France. In N.W. India McClelland has demonstrated this with an almost mathematical accuracy showing how strictly localised the disease is to the limestone formation.

At Clutesi on the Arne Aitken mentions how the lofty cliffs of mountain limestone tower above the town. The drinking water trickles through crenes in the rock. Many goitres and Cretins are to be met with.
Along the Sackethewan Sir John Franklin found goitre highly endemic. Limestone was very abundant all along the river.

In Sardinia where the disease is so common large tracts of mountain limestone are to be met with (Forrester Rambles in Corsica and Sardinia, etc.).

At Fribourg, Valletina, Berne, Pay de-dome, Dresden, Savoy and Piedmont the most remarkable districts in Europe for the prevalence of goitre. Alpine limestone constitutes the principal rock formation (McClelland p. 86).

Looking nearer home we find a typical example in England. We find goitre most intense along the Pennine chain the backbone of England as it is called, extending down from Northumberland to Derbyshire.

Throughout all this region we find the same formation prevailing viz. Carboniferous or mountain limestone. Goitre certainly occurs elsewhere in this country but by far means so frequent as along this tract.

It is noteworthy that on passing out from this central ridge on either side we find goitre no longer endemic as we pass out of the limestone area. Prof. Lebour in his interesting paper on the geology of the goitrous regions of England brings out this fact in a striking manner.

Speaking of the west of Northumberland and Durham he says the disease appears to be confined to the Carboniferous limestone.
series, “never encroaching upon the Cheviot porphyrites to the North-west or on the millstone grit and Coal measures to the East.”

Derbyshire, the most grotesque part of England is famous for its picturesque beauty, which it owes to its limestone formation which, by the ease with which it crumbles down under the influence of air and water, produces scenes almost alpine in their grandeur. Mr. Selborne speaking of England generally says: “The limestone series of the Carboniferous rocks whether it be represented by the foredale type of ledges, by the massive limestones of Derbyshire and Bristol, or the thin limestones of the Berncian area constitutes in England the great hot-bed of gothic, although there are some striking exceptions to the rule.”

The main pillar however upon which the limestone theory rests is the work of Dr. McClelland on the gothic of Kurnai a province of North-west India. He made a searching inquiry into the geology and water-supply of the gothins and non-gotinous villages of this district and tabulated his results with surprising exactitude. He found that all these villages which derived their water supply from the
Limestone rock contained many gòrí inhabitants, whereas those villages which
received their water from the clay-late &
other rocks contained few, a go gòrís
among their inhabitants. This rule held
good even in villages within a short distance
from another, corresponding in every particular
except in this one, of water supply.

There is one instance which I cannot
refrain from quoting, since it is referred to
by Sir Thomas Watson in his 'Prachëi of Phylé'
and as it seems a strong proof of the
limestone theory.

Dostā is a village lying at the foot
of a mountain of compact limestone.
It has a population of 100, comprising
three distinct castés; of the highest casté
all are free from gòrí. Of the middle casté
two-thirds are affected, and of the lowest
casté almost the whole.

There is no difference in the mode of life of
these three castés. All are alike well-fed
and live and labour in exactly the same
manner, but glance at the water-supply.
The village possesses two distinct supplies.
One from a neighbouring spring, the other
conveyed from a distance by means of an
aqueduct. The water from the latter
constitutes the sole supply of the highest
casté. The middle casté use both supplies.
they have two-thirds of their number affected while the low caste drink exclusively from the spring not being allowed to use the water from the aqueduct, and are all affected with goitre. Here we have indeed a remarkable instance of the effects of a limestone water upon the thyroid.

McCullough as a result of his enquiries found goitre to affect the various formations in the following proportion:

<table>
<thead>
<tr>
<th>Formation</th>
<th>Goitre in 500 Inhabitants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granite &amp; Gneiss</td>
<td>1 goitre</td>
</tr>
<tr>
<td>Mica Slate &amp; hornblende</td>
<td>5 — 192</td>
</tr>
<tr>
<td>Clay slate</td>
<td>1 — 3</td>
</tr>
<tr>
<td>Green Sandstone</td>
<td>0 — 3</td>
</tr>
<tr>
<td>Calcareous Rocks</td>
<td>1 — 3</td>
</tr>
</tbody>
</table>

From these figures we must conclude that calcaeous rocks in some way or other favour the development of goitre.

Another case supporting the limestone theory came within my own knowledge. Close to the district in which I lived is the mining district of Alston Moor in Cumberland. This is like the rest of the goitrogenous parts of England a valley or dale bounded on each side by hilly moorland. On the west side of this valley the
The signet of the above noted "Aquatic" or "Swimming" animals is a remarkable one. I have found fossilized remains of such animals in some of the localities where the corals are common. The following is an account of an interesting case in Edinburgh:

On May 1858, James Smith, a famous geologist, made an accidental discovery of a fish-like creature in a sample of the Old Red Sandstone. He named it *Echinodermata* and described it as a prehistoric animal with the following characteristics:

- Body covered with spines
- Five pairs of appendages
- Respired by gills

The following table shows the composition of the sample:

<table>
<thead>
<tr>
<th>Organic matter</th>
<th>Marls and clays</th>
<th>Lime sandstone</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.8%</td>
<td>5.3%</td>
<td>8.5%</td>
</tr>
</tbody>
</table>

This species, *Echinodermata*, is believed to have lived in the prehistoric era.
which undoubtedly produced goitri as by a change to another supply obtained from the Water Company from the River Wear the goitri rapidly disappeared without any other change being made in the prisoner's mode of life.

Dr. Sellar, writing of the town of Wishaw in Lanark (Edin Med Journal July 1853) says: "The presence of goitri in a district supplied by water containing a considerable proportion of lime and magnesia salts would lead one to the general belief that the drinking of it is the chief cause in the production of the disease."

Now after this account of the connection of goitri with limestone districts it will be generally admitted, I think, that those who hold this view are not without a strong chain of evidence in its favour (as a causative factor) hence this theory occupies a prominent place in most of our modern textbooks (Bastinove, Aitken, Roberti).

However, though I have adduced strong proofs in support of this theory, I think I can give equally strong proofs against it, showing to any unprejudiced mind that residence in a limestone district and drinking water containing a large amount of lime-salt is most certainly not the cause of goitri.