UNIVERSITY OF EDINBURGH.

M.D. THESIS. 1885.

On
ANÆMIA,
associated with
ENDEMIC GOITRE.

BY

Adam Macvie, M.B., C.M. (1882).

Helmsley, Yorks.
April 1885.
Introduction.

For more than two years I have been practising in a remote rural district in the North Riding of Yorkshire. During that period I have often been struck with the large number of anaemic patients who came under my notice for advice and treatment.

In conversation with the older resident medical men in the neighbourhood, I have been informed that this condition has always existed to a large extent among the inhabitants of the district.

The subjects of this anaemia are usually young persons past puberty, and principally of the female sex, but not entirely confined to them. What has further drawn my attention to this matter is the fact that going is more or less endemic in the locality.
There is also a marked and distinct predisposition to haemorrhage, shown more particularly by the comparative frequency of flooding in childbirth.

The connection between anaemia, goitre, and the haemorrhagic tendency has been before remarked, and undoubtedly there is a close relationship between the three conditions. Mr Lawson said in a contribution to the Edinburgh Obstetrical Society (and published in the Edinburgh Medical Journal for May 1873) on "Enlargement of the Thyroid Body in Pregnancy," stated that in the majority of his cases (of goitre) there was a marked tendency to uterine haemorrhage, and that the women in whom goitre was of long standing were always anaemic, and their menstrual periods were too frequent and very profuse. Again, in a paper contributed
to the British Medical Journal of June 29th, 1878 by Dr. R. Bruce. 

Lohy on, "Scurvey and the Haemor-
phagic Tendency," he says: "In 
this district anaemia was soon pro-
duced, when young females, es-
pecially from the south of England 
tome to reside here. This is a most 
frequent occurrence among the 
domestic servants of the neighbourhood. 

The majority of young girls, living 
in the small farm houses scatter-
ed over the moors, and in the sequest-
tered valleys are highly anaemic 
in appearance and are often under 
treatment for this condition." He 
further says: "There appears to be a 
great predisposition to scurvy in 
the district, so much so, that medical 
men of the neighbourhood are united 
in their opinion, that more care and 
attention are requisite after labour is 
over here than in other districts. 

He also gives statistics of 90 women 
who had some children, and ou
of these 21 were habitual sufferers besides these, a considerable number of others showed a haemorrhagic tendency, especially at their menstrual periods.

Although the haemorrhagic diathesis goes hand in hand with goitre (a fact which may account for the prevalence of anaemia in goitreous localities) still, there exists such a number of cases of anaemia, in which no affection of the thyroid gland appears to be present, and to which no cause can be attributed, that I have often been compelled to ask myself the question - Can the same hidden influences which act in producing the change in the thyroid gland, have any relation to the prevalence of anaemia where goitre is endemic.

Having a large number of cases at my disposal, both where anaemia and goitre accompany
each other, and where profound anaemia is present without any visible change in the hypochondria, it have thought it important to give an accurate description of the conditions under which these occur.

I shall therefore briefly describe the district, referring specially to its topographical position, its geological formation, configuration, and climate. I shall also describe the habits, occupations, and dwellings of the people generally. In several instances I made observations on the blood of the patients, by means of the haematoctometer and haemoglobinometer: these cases will be described in detail.

As what be conjectured, it is not easy in practice to select patients suffering from anaemia and carry on experiments without injuring them medicinally at the same time.
Fortunately, the practice with which I am connected possesses a Medical Provident Club, and this contains members of both sexes, some of whom regard their anaemia as a matter of course on the blood of those persons. I made observations before submitting them to a course of treatment with the drugs which have the reputation of doing good in such cases.

The results of the treatment will be seen at a glance on the charts appended to each case, and will be fully discussed farther on.

Description of the district.

Topographical position. The district is situated on the edge of the north eastern moorlands of Yorkshire. It forms the head of a
Strath, or open valley, which has been the bed of an ancient freshwater lake, or arm of the sea, extending in a straight line from Scarborough to Helmsley, a distance of thirty-five miles. The bed of the ancient lake is now a well cultivated plain, and presents a marked contrast to the bleak and barren moors which form its north and western boundaries.

The cases which I shall describe are taken from different parts of the district. viz.: (1) from the elevated moorlands; (2) from the valleys or dales, which intersect the ridges of hills, and (3) from the fertile plain.

In the accompanying map, the district I am describing is contained between the parallel red lines. The elevated moorlands referred to are coloured buff; the valleys or dales dark slate colour, and the plain, or Vale of Pickering, blue.
Geological Formation.

The district stands on the middle and upper calcareous formations. The plain consists of alluvium upon Kimmeridge clay, in which iron pyrites is found. The hills are mostly tabular, and consist of Kelladarp rock, Oxford clay, and cave grit.

In one valley alone at the extreme western boundary of the district is the rice formation met with.

On the following page I have presented in a tabular form, the geological formations which occur in the district, taken from "Memoirs of the Geological Survey," 46. S.E. By comparing the table with the accompanying map a clear understanding of the geology of the district will be obtained.

I have outlined the portion of the district with which I am acquainted, and from which I
have taken my cases.

Geological Formations.

Recent and Post Glacial
- Alluvium; warp and lacustrine clay, sand, and gravel.

Glacial - Boulder clay and gravel.

Upper Tithonian - Kimmeridge clay.

Middle Jurassic
- Upper calcareous grit; coral rag and upper limestone; middle calcareous grit; lower limestone; passage beds; lower calcareous grit; Oxford clay; Kellaways' rock

Lower Jurassic,

Lias.
Configuration. As before stated, the district is formed of plain, hill, moor, and valley. The hilly portion consists of a range known locally as the Hambleton Hills, which attain an altitude at their highest point of 1250 ft. above the sea level.

The spurs of these hills are intersected by deep valleys and ravines, which are densely wooded.

Climate. The climate is considered a healthy one. The mean annual death rate of the last eleven years is 17.26 per thousand of the population. Invalids are sent here in the summer months from the large towns of Yorkshire, and from the south, to inhale the soothing breezes which blow over the heather slopes of the north-eastern moorlands.

Rainfall. The rainfall of the
District is somewhat in excess of that recorded for England generally; the mean annual rainfall of the last five years (1880-84 inclusive) being 34.36 ins.

After heavy rains on account of the conformation of the surface, the rainfall speedily disappears swelling the streams which flow in each valley or "gill". The sub-soil is thin and being near the rock is soon dry, except on that portion of the district situated on the plain. In the low lying and stiffer wooded parts, a dense herbaceous mat, called a "rook" (known by the same name in Norway at the present day) often remains when the high ground is clear and bright.

Water Supply. The water supply is abundant and of good quality. It is chiefly derived from three sources, viz. (1) from the running brooks; (2) from
The springs on the hill sides; (3) from wells sunk in the rock or in the alluvium of the plain.

Although this is a goitrous district, contrary to the usual idea, the water is not excessively hard.

The majority of the people drink a water which contains not more than 15 grs of total solids per gallon. On the moors the water, as might be expected, is soft, containing as little as 2 grs per gallon. In the alluvium of the plain the water is harder, averaging from thirty to forty grains of total solids per gallon.

I am indebted to the local Medical Office of Health for the following table of analyses of the potable waters of the locality. This table shows the variations in the chemical composition of the water. From a study of these analyses no satisfactory reasons can be adduced for the prevalence of anaemia from their use.
Table of Water Analyses from Various Parts of the District.

<table>
<thead>
<tr>
<th>A.</th>
<th>B.</th>
<th>C.</th>
<th>D.</th>
<th>E.</th>
<th>F.</th>
<th>G.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grains per Gallon.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total solid residue</td>
<td>16.00</td>
<td>38.75</td>
<td>40.8</td>
<td>21.9</td>
<td>7.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Chlorine</td>
<td>2.90</td>
<td>2.30</td>
<td>3.5</td>
<td>1.3</td>
<td>1.20</td>
<td>2.00</td>
</tr>
<tr>
<td>Equal to Salt</td>
<td>1.12</td>
<td>3.80</td>
<td>5.76</td>
<td>2.14</td>
<td>1.97</td>
<td>3.20</td>
</tr>
<tr>
<td>Silica</td>
<td>0.76</td>
<td>1.60</td>
<td>3.56</td>
<td>5.6</td>
<td>2.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Oxide of iron and alumina</td>
<td>0.36</td>
<td>0.46</td>
<td>0.76</td>
<td>0.76</td>
<td>0.36</td>
<td>2.6</td>
</tr>
<tr>
<td>Carbonate of Lime</td>
<td>11.66</td>
<td>22.66</td>
<td>26.66</td>
<td>12.66</td>
<td>2.86</td>
<td>9.76</td>
</tr>
<tr>
<td>Sulphate of Lime</td>
<td>Trace</td>
<td>6.40</td>
<td>5.88</td>
<td>4.05</td>
<td>Trace</td>
<td>1.90</td>
</tr>
<tr>
<td>Magnesia</td>
<td>0.61</td>
<td>0.83</td>
<td>0.90</td>
<td>0.65</td>
<td>2.5</td>
<td>0.50</td>
</tr>
</tbody>
</table>

| **Parts per Million.** | | | | | | |
| Free Ammonia | None | 0.012 | 0.012 | 0.026 | 0.04 | None | 0.008 |
| Albuminoid Ammonia | None | 0.030 | 0.020 | 0.030 | 0.02 | 0.02 | 0.106 |

| **Degrees.** | | | | | | |
| Total hardness | 15.00 | 37.00 | 34.50 | 18.00 | 6.00 | 14.50 | 8.4 |
| Permanent hardness | 5.50 | 13.00 | 10.20 | 4.70 | 2.50 | 5.00 | 3.7 |
| Temporary hardness | 9.50 | 24.00 | 24.30 | 10.30 | 3.50 | 9.50 | 4.7 |

| Geological source of the water | Calc. grit | Alluvium | Calc. grit | Oxford clay | Estuarine sandstones and Limestones | Calc. grit, Alluvium |
| Situation of source | Valley | Plain | Hill | Valley | Mountainous Moorland | Hill-side |
| The water taken for examination from | Tapped from a reservoir which is supplied by spring | Well, 20 f. deep | Well 12 f. deep | Spring | Brooklet | Spring | River |
Habits and Surroundings.

Those who have locally studied the race assert, that the inhabitants of this part of Yorkshire "are descendants of the Scandinavians with a "dash" of ancient Briton's blood in their veins. They are speaking generally, of temperate habits, chiefly engaged in agricultural pursuits."

The diet of the poor class consists mostly of bacon, bread, and tea. Many parts of the district are divided into small holdings called "cow-keepings," and the tenants of these contrive to live on the produce of their cows which are kept on their small bit of rented land. Unfortunately for themselves, they do not as a rule make milk an article of diet, as this would affect their quantity of butter at the weekly market.

The dwellings. Although it is my intention to describe in detail the dwellings from which
Some of the cases are taken, I may mention here that these small houses are, as a rule, of a most unhealthy type. They are old and dilapidated, small in size, badly ventilated, there being frequently no fire-places in the bed-chambers. They are insufficiently lighted, the windows being exceedingly small and usually do not open.

The walls of the houses are mostly built of undressed stone, and having stood the "pelting of the pitiless storm" for years, are damp and decayed, and they give rise to a musty smelling vapour which renders the dwelling mucky and unhealthy.

The roofs are mostly tile or thatch, where the latter forms the covering it may be compared to a manner sheep on the house top, for, the rotting straw, harbouring vermin, becomes a mass of dirt, damp, and decomposition.

On more than one occasion within my knowledge, during confinements for example, it has been found almost
impossible to obtain any space enough for the patient's bed, owing to the rain coming through the roof in all directions.

The flooring as well as the roof is often decayed and worm-eaten. I have known the legs of a four-poster bed, upon which a young woman was in the act of giving birth to a child, come crashing through the floor, to the consternation of an aged relative sitting in the kitchen below, waiting patiently for the arrival of the little stranger.

The extra weight occasioned by a woman kneeling on the bed to assist the patient, causing the accident.

The most that can be said in favour of these small houses is, that with their white washed walls, they form, especially in summers time, a beautiful and picturesque scene.

It may be surmised that the conditions already described are in themselves sufficient to explain, almost conclusively, the prevalence of anaemia,
and doubtless they play an important part in its production. But even those placed in the most favourable sanitary surroundings locally, suffer from anaemia. For example, an earl's daughter, aged 14, living in the midst of luxury and comfort, with every modern improvement and appliance for the protection of health, is the subject of profound anaemia. Again, the daughter of a wealthy merchant, living in the most favourable circumstances, suffers from anaemia of the most marked character. These, and other instances of the same sort, which might be adduced to show, that insanitary conditions alone are not the sole factors in producing the symptoms referred to.

With these facts before me, at a time when the precise function of the thyroid gland is unknown, and its pathology attracting considerable attention, I thought it important to make a series of observations on the blood of anaemic and goitrous
patients, the nature of which I shall now describe.

Examination of the Blood.

Before recording the results of observations on the blood in cases of anaemia, I previously made myself acquainted with the methods of procedure by making frequent examinations of my own blood and that of a few friends outside the profession who were extremely interested in the process. By this means I learned what were the characteristic appearances of normal healthy blood after being mixed with a diluting solution, and was the better able to determine at once any deviation from the normal, when a morbid condition was present.

The patients whose cases I have recorded, almost without exception came to the surgeon and at the same hour of the day, viz., four in
the afternoon, (two hours after food)  

In a very few instances only did I venture to their homes and examined the blood there.

The instructions laid down by Dr. Gowers in his description of the haemacytometer and its use, have been strictly carried out, and the precautions carefully observed. As will be seen also from the charts, the simplest method of recording the average number of corpuscles has been adopted.

That is, the quantity of the dilution contained in two squares of the cell is taken as the "haemic unit." In the healthy adult this quantity contains on an average 100 red corpuscles and a normal maximum of white equal to 0.3 per two squares (haemic unit)

The diluting solution used was that known as Gowers' and has the following composition:

- Sulphate of Soda: Gns 104
- Acetic Acid: 3⅔
- Distilled Water: ...
The average number of red was ascertained by counting 10 squares; that of which I obtained by counting the number contained in 80 squares. Before treatment was commenced the blood in each case differed from that in health as follows:

1. To the naked eye it looked pale and thin, and it flowed from the finger very slowly. Even after pricking the finger several times it was difficult to get sufficient to fill the pipettes for observation. This would indicate that the total quantity of blood in the system was diminished.

2. When tested with the haemoglobinometer the colouring matter was always far below normal; in one or two cases there was only 20 per cent. of haemoglobin.

3. On microscopic examination the field of achænic blood showed at once a marked contrast to that taken from a healthy person. The first thing observed being the greatly diminished quantity of red cells;
These were thinly scattered over the field, and in the case gave an average of only 40 per haemio unit. (= 2,000,000 per cubic millimetre).

The character of the corpuscles themselves, differed invariably from the normal, being imperfect both in size and shape. Leaving out of consideration those cells which swelled to abnormal dimensions from the action of the solution, there were always present numbers of very small corpuscles whose diameters did not measure above half that of an average red cell.

The outlines of the cells took a variety of forms; the chiefly to be noted being pear-shaped, and similar to some which I once saw in a specimen of blood from a patient suffering from pernicious anaemia in the wards of Edinburgh Royal Infirmary.

In no case was there the distinctive, round, well-developed cells as met with in normal blood.
So marked was this defect in shape, that on several occasions, I was persuaded there must be some fallacy of observation, and immediately submitted a quantity of my own blood to the same process, which test made the contrast all the more striking. I have endeavoured to show this difference in the following rough sketch:

A. Blood from Case I  
Red average 60 per hematoic unit  
White " "  

B. Blood from writer's finger  
Red average 100 per hematoic unit  
White " 3 "  

With regard to the leucocytes, during the whole of my observations there was nothing marked. In one instance only their members...
Exceeded the normal maximum, and at times their relative proportion to red was increased.

Occasionally patches of highly refractive granular material were seen on the field, as if produced by the breaking down of white corpuscles. In those cases where an increase of red cells followed the administration of iron, the white corpuscles appeared to be smaller in size than usual, and increased proportionately with the red.

Before describing in detail the cases upon which I have made observations, I may remark, that the symptoms in each were almost identical, differing only in degree.

The first case is a very typical one, and I have gone more fully into its description than will be necessary in those which follow.

Servant. Has suffered more or less for six years from palpitation, faintness, shortness of breath, swelling of the ankles, and extreme pallor.

Family History. Her father died seventeen years ago from heart disease. He had always been delicate. Four years before his death he was bled, the doctor remarking that "the blood was as thin as water." Her mother is alive and well, but has an enlarged thyroid gland. The only other members of the family are two sisters, both of whom are profoundly anaemic, have goitre, and the eldest is subject to epileptic fits.

The water supply was that marked A on the Table p. 12a.

Home Surroundings. The home surrounding are comparatively comfortable, and the diet although consisting chiefly of bacon and bread, has always been plentiful.
The house in which she lives, faces due north, is old and of faulty construction. The floor is ordinary clay, unboarded, and without concrete. It is 4 inches below the level of the road in front, and 21 inches below the level of the garden behind. There is no impervious layer, or damp-proof course in the walls, which suck up the moisture and become "black wet." There is no spouting on the house. One wall is separated from a stable by a covered passage four feet wide. In the sitting room unpleasant odours are often felt from the stable. The dimensions of the sitting room afford an average space of 210 cubic feet to each occupant.

This room is lighted by two windows (back and front) each measuring 3 ft by 2 ft 4 inches. These windows open with a sliding movement, and consists of small panes about 5-inches square. The amount of light supplied is scarcely sufficient to enable one to read
During the day, the bedrooms are small, dark, and have no fireplaces.

I have visited, and made myself acquainted with the different houses in which this girl had lived since infancy, and they are even worse than that in which she now resides.

Before treatment, the various systems were affected as follows:

**Alimentary System.**

The lips, tongue, gums, and fauces, were bloodless; teeth quite decayed; appetite fairly good; constipation habitual.

**Haemopoietic System.**

There was slight enlargement of the thyroid gland.

The blood was pale & deficient in quantity. The number of red corpuscles averaged 50 per haemioic unit. (or half the normal). They were irregular in size and shape. The leucocytes were reduced proportionately and gave an
average of somewhat less than 9 per haemetic unit. (Or in proportion to red = 15330). Patches of granular matter were seen on the field. The amount of haemoglobin was 40 per cent.

**Circulatory System.** There was no organic disease of the heart, although auscultation of the heart showed a murmur could be heard all over the precordium and in the larger vessels of the neck where there was constant throbbing. There was palpitation after undergoing the slightest exertion, and the patient sometimes fainted at her work. The pulse was small, feeble, regular; its rate averaged 120 beats per minute.

**Respiratory System.** Shortness of breath always accompanied the palpitation, and when perfectly still, the respirations numbered 25 per minute.
Integumentary System. There was slight oedema of the face, which, with the poverty of blood gave the patient a pale, sickly look. Oedema was specially marked about the ankles.


Reproductive System. Menstruation began at the age of 15. It has always been of an irregular character, occurring once in two or three months, and even then very scanty, lasting only two days.

Nervous System. In connection with the nervous system it may be mentioned that the vasomotor function was particularly susceptible to emotions. The facial integument quickly changed from extreme pallor to a highly flushed condition at the least excitement, and quite as suddenly returned to paleness again.
Great languor and unfitness for exertion were often experienced. Sleeplessness and headache in a more or less degree were almost constant symptoms.

A marked improvement on the general condition of the patient supervened on the administration of iron (15 minims Liquor ferri perchloridi, three times daily after food). The blood improved both in quality & quantity as could be seen with the naked eye as well as on microscopic examination. After the first week's treatment there was a steady rise in the number of red corpuscles, and in one month from the commencement of treatment their number had reached the normal. (100 per haemocyt.) The white corpuscles had risen in proportion and attained the normal maximum before the red. The red cells were still abnormally small although less irregular in shape. On March 2nd sickness was complained of, and the medicine stopped, a circumstance
which may explain the fall to 80 per haemocite unit on the chart. On March 4th the treatment was persevered with, a smaller dose (10m.) of iron being taken, and further benefit derived. On April 4th the red corpuscles averaged 115 per haemocite unit, but notwithstanding this the haemoglobin was only 80 per cent. The smallness of the corpuscles might account for this.

**Chart for Recording Variations in the Number of Blood Corpuscles.**

- **Name:** Ruth Worley, Age 20
- **Disease:** Anaemia and Goitre

The percentage of Corpuscles is the average number in two squares of the haemocytometer (i.e. 0.00002 cubic millimetre of blood). The two lowest divisions of the Chart are of greater width, and divided into tenths, for recording the average number of White Corpuscles per two squares obtained by observing the number contained in a larger number of squares and taking the mean. The upper broken line (at 100) represents the average number of Red Corpuscles in health. The lower broken line (at 3) represents the normal maximum of White Corpuscles. The vertical lines may represent one or two days according to the frequency of observation.
Case II. Jane Collier. Aged 37, married. Had suffered from anaemia for years. Home surroundings and habits are similar to those described in Case I. She has a good family history and enjoyed fair health until the age of 18, when she remembers being very pale, languid, and listless, a condition which has persisted more or less ever since.

At that time she suffered from epileptic fits, and had a swelling of the thyroid gland, which however gave her no trouble; in fact, she did not know of its existence until her attention was drawn to it.

The water supply is that marked A on the table at p.112.

Menstruation commenced at the age of 18, and has always been irregular, coming on about once in three months and small in quantity. She has had seven children, two of whom died in infancy from convulsions. It is interesting to note, that at the age of
twenty-one, after the birth of her first child. The fits left her. All her labours have been complicated with flooding, notwithstanding the greatest care. I attended her in her last confinement, a year ago, and in spite of every precaution the haemorrhage was so profuse as to cause prolonged and recurrent syncope.

Observations on her blood were commenced about the middle of January of the present year, nine months after her last confinement. The red corpuscles averaged 60 per haemocrit unit (2,000,000 per cubic millimeter) and were irregular in size and of the same ill-formed character as those already described. There was also a diminution in the number of white corpuscles. The blood contained 40 per cent of haemoglobin.

A course of treatment consisting of iron and digitalis was begun on 11.30. From this date, her condition gradually improved. The number of red and white
Corpuscles steadily increased, and in less than two months had reached the normal average. Both the red and white cells however were smaller in size than normal; but compared with this increase in the number of cells, there was only an improvement of 15 per cent in the amount of colouring matter. (See chart.)

**Chart for Recording Variations in the Number of Blood Corpuscles.**

The percentage of Corpuscles is the average number in two square of the hemocytometer (i.e. in 00002 cubic millimetre of blood). The two lowest divisions of the Chart are of greater width, and divided into tenths, for recording the average number of White Corpuscles per two square according to observing the number contained in a larger number of squares, and taking the mean. The upper broken line (at 100) represents the average number of Red Corpuscles in health. The lower broken line (at 50) represents the normal maximum of White Corpuscles. The vertical lines may represent one or two days according to the frequency of numération.

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Case III. George Bulmer, aged 18, farmer's son.

Suffering from anaemia. He has always been in fair health until about two years ago, when the anaemic symptoms commenced.

The family history is good; his father and mother are both alive and well. He has three brothers all healthy, and an only sister who constantly suffers from anaemia, and is often under treatment for that condition. He has always been in good circumstances, and is of steady habits. The house in which he lives is a comparatively healthy one, although the living rooms face due north. He lives much of his time in the open air, as a consequence of his occupation. The water supply used is that marked B on the Table p. 12a.

In connection with this case it is important to note, that in a house not over 50 yards distant from the patient, a man died a few years ago of Chronic Persimmon Anaemia, and I have lately attended his widow, who now suffers from anaemia of a persistent and obstinate nature.

Bulmer's blood was first examined on Feb. 18. It was then extremely poor, the red corpuscles averaging only 40 per haemio unit, and the haemoglobin reduced to 20 per cent. The same unhealthy features...
of the corpuscles was present, a sketch of which accompanies the notes on Case 113, p. 36, Fig 3.

The good effect of iron was well illustrated in this case, such benefit being derived at once that he gave up taking medicine at the end of a fortnight. As was to be expected a relapse took place. Treatment was resumed and the progress was uninterrupted as may be seen at a glance on the chart.

**Chart for Recording Variations in the Number of Blood Corpuscles.**

<table>
<thead>
<tr>
<th>Name</th>
<th>George Bulmer, Aged 18</th>
<th>Disease</th>
<th>Anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 14th</td>
<td>70%</td>
<td>Treatment Started</td>
<td></td>
</tr>
<tr>
<td>Test 21st</td>
<td>80%</td>
<td>Treatment Started</td>
<td></td>
</tr>
<tr>
<td>Test 28th</td>
<td>90%</td>
<td>Treatment Started</td>
<td></td>
</tr>
<tr>
<td>Test 35th</td>
<td>100%</td>
<td>Treatment Started</td>
<td></td>
</tr>
</tbody>
</table>

The percentage of Corpuscles is the average number in ten square of the haemacytometer (i.e. in $0.0002$ cubic millimetre of blood). The two lowest divisions of the Chart are of greater width, and divided into tenths, for recording the average number of White Corpuscles per ten squares are taken by observing the number contained in a larger number of squares and taking the mean. The upper broken line (at 100) represents the average number of Red Corpuscles in health. The lower broken line at 95 represents the normal maximum of White Corpuscles. The vertical lines may represent one or two days according to the frequency of enumeration.

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Case IV. Lucy Grie, aged 21, housemaid, had suffered from profound anaemia for the last three years. She has a good family history and had been in excellent health until three years ago when she came to reside in this neighbourhood, all her symptoms dated from that period.

In addition to the anaemia there was a gradual enlargement of the thyroid gland. This caused no inconvenience except that it was "unsightly." The house in which she lives is loft, roofed, damp, and badly lighted.

The water supply used is the same as that mentioned in Case I & II. Menstruation began seven years ago, has been regular in character and normal in amount, lasting from 4 to 6 days.

Observations on the blood were begun on Feb. 24. The defect in the blood, both as regards the number of its cellular elements and the amount of colouring matter, was most marked, as
will be seen from the chart.

The imperfect character of the individual corpuscles was also very distinct. There was only 20 per cent of colouring matter present.

On the following illustration, fig. 3 and 4, I have given a genuine copy of the specimens of blood taken from cases IV and V, respectively.

![Fig. 3](image)

Blood from Case III (Bulmer), showing irregularity in size and shape of red corpuscles.

![Fig. 4](image)

Specimen of blood from Case IV (Girice), showing the same irregular character of the corpuscles.

The usual treatment was adopted but without the success met with in the preceding cases. Although the patient
said she felt on the whole improved, there was no actual improvement to record on the chart after repeated examinations of her blood.

On March 9th, a combination of quinine, iron, and phosphorus was given in the form of pills, but the results were still unsatisfactory, so that at the end of observations the condition of the blood was very little better than at first.

**Chart for recording variations in the number of blood corpuscles.**

- **Name:** Lucy Price, Aet. 21.
- **Disease:** Anaemia and Goitre.

The percentage of corpuscles is the average number in two squares of the hemacytometer (i.e., 0.00002 cubic millimetre of blood). The two lowest divisions of the Chart are of greater width, and divided into tenths, for recording the average number of white corpuscles per two squares, ascertained by observing the number contained in a larger number of squares, and taking the mean. The upper broken line (at 100) represents the average number of red corpuscles in health. The lower broken line (at 70) represents the normal maximum of white corpuscles. The vertical lines may represent one or two days according to the frequency of examination.

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Case V. Jennie Nelson, aged 18, flame-bodied, in good circumstances, has suffered from anaemia for four years; there is slight enlargement of the thyroidea gland. Her father and mother are alive and well, the latter has a goitre. She has two sisters and a brother; the last mentioned suffers from chorea. The two sisters are goitrous and have often been under treatment for well-marked anaemia. Both of them are governesses, and it is interesting to note, that when they reside away from home they enjoy comparatively good health, but when they are at home anaemic symptoms gradually develop.

In connexion with this case, I may mention that recently I was called in to see a servant-girl who had been sent home from her situation suffering from general bloodlessness. On inquiry, I found that she had been serving for the last six months at the house of Jennie Nelson (whose
The house is roomy, and well lighted with a South-Eastern aspect. The ground floor is 8 inches below the level of the garden soil outside.

The lower rooms are always damp, and have to be re-papered annually. There is constantly a musty or mouldy smell in the rooms.

The water supply used is that marked C on the Table of Water Analysis, page 12 a. The water is brought from the river, a mile distant, by means of a water-cart which holds sufficient to last the family for about a week at a time.

In this case the extent of the anaemia at the commencement will be seen by a reference to the accompanying chart.

The iron treatment was again successful, and at the end of the month, the patient expressed herself so much improved, that she declined...
any further treatment, although the number of corpuscles only averaged 80 per litre of unit, and the haemoglobin 55 per cent.

The white corpuscles were present in rather larger proportion, having reached the normal maximum averaged viz. 3 per litre of unit.
Case VI

Ellen Brenster, aged 23. Housemaid. had suffered from anaemia for a year. Father died from injuries received in an accident; her mother died from cancer. She has seven sisters and two brothers all living and in good health. She attributes the commencement of her illness to close confinement in a milliner's workroom, where she remained six months, but gave it up owing to her anaemic symptoms. Acting on the advice of her friends she took a situation as housemaid in a gentleman's family, in the hope that the better diet and more healthy surroundings would benefit her. When the observations on her blood began, the anaemia had been absent for four months. The pallor was extreme and the breathlessness and dyspnoea distressing.

A short course of iron was given. This, with the generous diet and improved hygienic conditions, brought about a marked improvement in her symptoms. Menstruation was not re-established until she had been four months in her new situation. As usual, after the first improvement was felt there was great difficulty in persuading her,
to continue the iron treatment, which was stopped far too soon.

So the non-continuance of the treatment may be due the fact, that although the proportion of blood corpuscles gradually increased reaching the height of 80 per. haemato crit yet the per centage of haemoglobin after the stoppage of the iron, remained almost the same.
In the preceding pages I have given an honest and unprejudiced account of the various local conditions under which anaemia is prevalent in unusual proportion, and where goitre is endemic. The cases which I have described show the degree of anaemia in the individual, and are typical examples of numerous others which are still, or have been, under treatment.

It is, however, to me a matter of regret that I did not at an earlier period in my observations, institute a statistical inquiry on the subject. I must content myself with stating that from my own knowledge, and from the testimony of the local medical practitioners whom I have interrogated, that anaemia is endemic in the neighbourhood.

I purpose now to refer briefly to the relation which these allegations, viz., anaemia and endemic goitre, have to one another.

It has struck me as being of
much significance that some degree of anaemia almost invariably precedes the thyroid enlargement. An inquiry into the history of women in whom goitre is of long standing confirms this view.

It will be observed that the description of the district and the dwellings embraces all those so-called "multiple causes" to which the origin of goitre is assigned. These are: inhabitants, a district comprising valleys, humidity of air and coir, stagnation of air, especially in valleys, unhealthy dwellings, and want of sun's rays.

So far as the analysis of the waters of the district goes, no light is thrown upon the causation of anaemia or goitre. It is evident that hard water, per se, does not produce enlargement of the thyroid, for goitre is endemic in part of the district, the water supply of which contains as little as 7 grains of total solids per gallon. (See Table
page 12a. E.)

The cause of the majority of the anaemic cases can be attributed to the unhealthy state of the dwellings, and especially to dampness, a condition common to all the houses which have supplied me with cases.

The effect of breathing constantly in a damp atmosphere, in a dwelling ill-ventilated and badly lighted, is to cause a deterioration of the blood, which is not sufficiently aerated, and therefore unable to perform the important function of carrying oxygen to the tissues. One of the first reflexes of this deterioration is an acceleration of respiration and the heart action.

It has occurred to me that such a state of the circulatory system is a possible cause of enlargement of the thyroid gland. In profound anaemia, paroxysms of palpitation are produced on the
Slightest exertion or nervous excitement. These attacks are accom-
ppanied by intense throbbing in the vessels of the neck. And when we 
consider the relaxed condition of the arterial walls, the watery state of the 
blood which facilitates its flow, and 
bearing in mind that the thyroid 
is largely supplied with blood vessels, 
it is not difficult to believe that a 
swelling of the gland may be pro-
duced by mechanical action alone.

This theory has been maintained 
by Henoch and others, in explanation 
of the enlargement which takes place 
in ophthalmic goitre. Hermann 
Beigel considers this theory untenable 
although the cases which he quotes 
are not entirely against it. (See Reynolds' 
System of Medicine, Vol. V. p. 376.)

As far as personal observation goes, 
I think the mechanical theory of 
some value. For example, in cases 
where only a trace of enlargement of the gland is present, a greater fulness
of the neck is felt during menstrual periods, when there is congestion of the system generally. And it is a well-known fact, that goitre is frequently felt for the first time during pregnancy, when the propelling force of the blood becomes temporarily augmented.

Lastly, the good effects of digitalis and iron, by slowing the heart's action, giving tone to the blood vessels, and improving the character of the blood, in some cases even causing a goitre to disappear, seems to establish a close connection between a morbid condition of the circulation and an enlarged thyroid.

With regard to the examination of the blood, I must confess to having had some preconceived notions as to the function of the thyroid in manufacturing white corpuscles, and it was with no little enthusiasm that I began making observations with the Hæmatoctiometer & Hæmoglobinometer.

In relation to the thyroid as a
blood forming gland, the results of my observations are contradictory and obscure. Blood taken from goitrous women whose necks measured up to 19 inches in circumference, could not be distinguished from other specimens taken from cases where no enlargement of the gland existed.

In the case of an old woman over 50 years of age, whose goitre was a perfect "wall of flesh," the red corpuscles averaged 90 per haemocritum and the white 0.3.

It must be admitted that our knowledge of endemic diseases, and especially goitre, which is the endemic disease "par excellence," is still very imperfect. The reason of this is not far to seek. The disease occurs in remote and thinly populated parts of the country.

The local practitioners have been apathetic, and have had no enthusiasm for the investigation of the origin of disease. The present
Knowledge of the etiology of goitre is derived from books in which the old and threadbare theories are repeated over and over again. Each author quietly copying the views of previous writers, taking no pains to satisfy himself of the soundness of these views.

It is impossible for the hospital physician in his daily work to find materials for compiling a correct etiology of endemic goitre, for these are not ready to his hand.

Nor is it possible for any local medical man with all the necessary material around him in a goitreous district to solve this problem by himself. It can only be done, by the careful and continuous collection of facts by earnest workers in various parts of the country; and by the investigation and comparison of these facts by competent authorities who have the time and the talents for such work.
The recent development of the science of public health has drawn special attention to the prevention of disease. Prevention of disease cannot be scientifically carried out unless a clear understanding of its etiology is first obtained.

It is therefore the duty of everyone who has at heart the study of the modes of preservation of health and treatment of disease, to record any facts which may tend to throw light on the etiology of endemic diseases or co-existing complications, however obscure; and it is with this aspiration that I now venture to offer an humble contribution on the subject of anemia and its relation to endemic goiter.