

THE PREVALENCE OF THYROID ENLARGEMENT IN AND ABOUT HEREFORD.

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UNDER the title of "The inference of local degeneracy from a comparison of the vital statistics of the people," the late Dr C. S. Morrison, Medical Superintendent of the County and City Asylum, Hereford, published a somewhat alarming account of the local conditions (*Journal of Mental Science*, vol. LIII, 1907, p. 795). After showing that the mean quinquennial rate of admissions to the Asylum had risen from 4·8 per 10,000 inhabitants in 1871–1875 to 7·0 in 1891–1895 and after a slight drop in the succeeding period to 7·2 in 1901–1905. (not including boarded-out patients in the latter case), he proceeds to remark upon the prevalence of thyroid insufficiency. His words may be quoted as follows: "From records available, I find that the number has risen from 2·5 % of the admissions in 1886–1895 to 10·5 % during the decennium 1896–1905, and last year we admitted 3·7 % males and 33·5 % females with goitre. Allowing for any personal equation and any fuller observation made in the last decennium, the increase is sufficiently striking to be recorded, and has, I think, an important bearing on the issues of degeneracy shortly commented on in this paper. When we remember that thyroid insufficiency is associated with cretinism and myxoedematous insanity at one end of its evil chain, and an enormous number of minor mental and nervous retrogressions at the other, the evidence that thyroid disease is more prevalent in a community than it used to be, becomes one of serious import. It comes as a stranger within the gates we should like to eject!"

It was in fact a matter of common knowledge that goitrous necks were common in the rural districts of parts of Herefordshire, but latterly there is evidence that the diseased condition has invaded the city itself. The object of this communication is to call attention to the seriousness of this invasion. It is hardly possible to ascertain by direct evidence when it began, but some suggestion will be made in the following paragraphs.

STREET OBSERVATIONS.

The introduction of the fashion of low or open necks as a part or rather a deficiency of modern female attire made it possible to observe the condition of the necks of individuals as they passed one in the street. From this somewhat casual mode of observation, one was forced to the conclusion that thyroid enlargement was quite a common condition in Hereford, whilst similar appearances were rare or unseen in strolls through the streets of towns in other districts. Whilst in other places hardly a single instance of thyroid

derangement could be observed, in a similar time in Hereford a dozen or more cases could be counted. It soon became apparent that the condition was not only observable on market days, when the town is filled with folk from the countryside, but that the town dwellers themselves were affected in considerable proportion. In 1916 the picture was rather blurred by the immigration of several thousand women, who came to work in the local shell-filling factory.

RECRUIT EXAMINATIONS. DISTRIBUTION OF THE DISEASE.

It is difficult, nay hardly possible, to give any thorough account of the regions which are most affected in the locality. A medical practitioner of the neighbouring town of Leominster, when questioned on the subject replied that "every other girl, you saw there, had a large thyroid"; and this though no doubt somewhat of *façon de parler* shows that the condition is widely spread there. The medical examination for recruiting, with which I was for a time engaged, afforded an opportunity for obtaining more information on the subject; though of course from piecemeal material it is impossible to base any proportion to population. The "rake-over" of re-examinees in the early part of 1918 mostly produced very poor types of manhood; on some days I counted as many as 1 in 8, 1 in 10 and 1 in 11 individuals with marked thyroid enlargement. Questions were put to ascertain that the condition had not been acquired elsewhere, and only in one case did it appear that the disease was of extra-comital origin—a lad from Derbyshire in whom it was a "family condition." It is generally accepted that thyroid derangement is far more common amongst women than men, so that these large proportions amongst the male sex are of considerable significance. One gained the impression that it was especially from the northern and western parts of the county that the cases were domiciled; it was only after a considerable number of cases had passed through that one single one was recorded from the Ross district, and he asserted that he had always lived there.

City cases.

Eventually two lads were presented who gave clear accounts that the enlargements they had had been acquired and developed during residence in the city, which is confirmatory of the conclusion that many of the numbers of quite young affected girls that one sees in the city have acquired their derangement whilst domiciled there. One of these two lads of 18 years definitely stated that he had lived all his life in the city and that the swelling in the neck had appeared two years before (*i.e.* in 1916). The other also gave a history of continued residence in the city but could not give any date for the onset of the enlargement, a question which is of interest in connexion with changes in the water-supply. It is possible that a certain amount of statistical knowledge might be excerpted from the medical history sheets of the recruits, but unless special attention happened to have been given to the matter the records could hardly yield a true maximum.

CAUSATION.

Tradition has associated a causal connexion between goitre and water supply. Later and more stringent observations have tended to establish such a relationship. Earlier observers thought that "hardness" of the potable water-supply had its influence or at any rate that some mineral constituent was the cause; later the theory was started that some bacterial influence was at work, and after being under a cloud for many years, the bacterial theory has been revived notably through the work of R. McCarrison (*Etiology of Endemic Goitre*, Milroy Lectures, Bale, Daniellson, Ltd., London, 1913, and *The Thyroid Gland*, Baillière, Tindall and Cox, London, 1917). It has been adequately proved that boiling the water, if thoroughly done, renders it innocuous; it has also been shown that filtration through an unglazed porcelain filter likewise removes the noxa, which indeed may be demonstrable in the residue removed by the filter; less effective filtering agents such as the Berkefeld diatomaceous filters are not able to hold back the active agent, which also is unable to pass a dialysing membrane. Injurious water has been rendered harmless by antiseptics such as Hydrogen peroxide. These facts point to the conclusion that there is either a contagium vivum or some chemical body which is sensitive to, or destroyed by, these detoxicating means. Three theses may be staged that goitre is caused: (1) by some mineral agency in the water, (2) by some bacterial agency through pollution of the source, (3) by the combined action of these two agencies.

From the fact that removal to another district in which the disease is not endemic leads to recovery, it may be concluded that the supposed living virus cannot have great power of survival within the body; the same may be said of recovery during continuance of domicile in the dangerous area, care being taken to drink boiled water only (cases of both sorts have come to my knowledge locally).

Mineral agencies in the water.

It is quite clear that mere "hardness" of water, that is an undue content of calcium and magnesium compounds, cannot in itself be the direct cause. It may however be stated that the water of the countryside wells is highly charged with these two elements. Thus a well water I examined in 1908 and again in 1912 showed:

Alkalinity to methyl orange	5.6 to 4.75 c.c. N/1 acid per litre
Calcium (as CaO) "temporary"	0.133 per litre
" " "permanent"	0.057
	total 0.190
	(another observation 0.198)
Magnesia (as MgO) "temporary"	0.008
" " "permanent"	0.0048
	total 0.0128

Potassium and sodium } (combined chlorides) }	0.080
Sulphates (as H ₂ SO ₄)	0.067
Chlorides (as Cl)	0.031

In 1912 the town service water, during use of the old filter beds, gave:

Alkalinity	...	...	...	1.4 c.c. N/1 per litre
Total CaO	...	...	...	0.0554
Total MgO	...	...	...	0.0005
H ₂ SO ₄	...	...	...	0.0105

In 1908, soon after Dr Morrison drew attention to the matter, I made some endeavours to determine whether some other constituent might have escaped attention such as strontium, but limitation in facilities precluded any satisfactory concentration of fractions from so large a quantity of lime. In regard to other metals, it may be noted that the Old Red Sandstone soils of the neighbourhood contain easily demonstrable amounts of manganese and titanium.

Let us now turn from the kations to the anions. The importance of the thyroid in relation to the iodine metabolism of the body has long been recognised, and it is not impossible that other halogen elements may also be dealt with therein, perhaps at the expense of the iodine. Chlorine may be put on one side and perhaps also bromine, for prolonged administrations of bromides have not evoked any remark concerning thyroid derangement. Fluorine is left for consideration, and gives rise to some points of interest. It appears to be many years since any thought of connexion between fluorides and goitre has been entertained; on searching the literature I find that Rabuteau (Paris, Baillière, 1867, 8vo., p. 144) was quite assertive on the subject. Nicklès (*Comptes Rendus Acad. Sci.* 1857) stated that all waters containing dissolved bicarbonate of lime also contained fluorides of calcium; Répin (quoted by McCarrison) stated that all goitrous waters were heavily charged with carbonic acid. Hitherto the chief attention in regard to fluorides has been centred on the bones and teeth. Rabuteau gives the following distribution of goitre in or about 1866, which perhaps is worth reproducing as the work is probably not to be found in every library (the Roy. Coll. Surgeons, London, England, possesses it).

Estimated goitrous persons per 100,000:

Côte d'Or...	...	...	55	Bas Rhin...	...	...	164
Marne	...	...	70	Haut Rhin	...	...	288
S.-et-Oise	...	...	46	Vosges	...	...	410
S.-et-Marne	...	...	37	Ariège	...	...	734
S.-Inférieure	...	...	33	Hautes Alpes	...	...	951
Seine	...	...	7				

Beyond insisting on the high content of fluoride in the waters of Contrèxeville, he does not carry the matter to the extent of giving the abundance of the compounds of fluorine in the other regions. Much importance is credited to an experiment by Mauméné on a bitch which was given doses of fluoride

of potash for five months and which three years later still had an enlarged thyroid; the story is not quite clear, for the dog was apparently lost for a time, moreover no detailed examination of the organ appears to have been made.

Brandl and Tappeiner (*Zeitschr. f. Biologie*, N.S. vol. x, p. 518, 1891) made a number of detailed observations on a dog which received large doses of sodium fluoride over a period of eight months, but unfortunately no attention was paid to the thyroid or associated glands in their elaborate analyses. Abegg (*Handbuch. d. anorgan. Chemie*, iv, p. 25, 1913) quotes observations on cattle which had fed upon the sludge from spirit factories, in which fluorides were used as yeast purifiers, but attention appears only to have been paid to the derangements in the bones.

On the other hand, McCarrison states that hydrofluoric acid has been administered with satisfactory results as a remedial agent.

The amount of attention which has been given to fluorides is perhaps exemplified by their entire omission in the toxicologies of Dixon Mann, Wvnter Blyth, and Taylor; Kobert gives a few paragraphs on the subject. The question whether fluorides or silicofluorides have any share in disturbing the normal course of the thyroid would appear to be unanswerable at present though it might well form a field for enquiry.

THE WATER-SUPPLY OF HEREFORD.

It is laid down by McCarrison that a polluted water-supply and possibly contact with polluted soil, form the means whereby goitre is acquired and spread. Since some indubitably, and many probably, city-acquired cases of thyroid enlargement have occurred, the question of the water-supply becomes one of importance, and may be dealt with both from the mineral and bacterial standpoint. So far as can be ascertained the disease used not to arise within the city, and it is only in the last few years that it has done so. The water has always been pumped up from the river Wye into storage tanks whence it passes through filter beds of gravel. At Hay, especially, and no doubt here and there on its course, the river is liable to pollution from the riparian inhabitants. Here it may be noted that Hereford is remarkably free from typhoid fever and that the few cases which have been treated there have always been importations from without; so that one line of evidence of pollution is absent.

In this connexion, I understand, some years ago action was contemplated with the view of putting restraint on the Hay authorities, but nothing so far has been done. As a matter of history rather than as an argument in the discussion, it may be mentioned that Hereford has enjoyed the reputation of having escaped, when other places were ravaged by cholera; on the one hand the water-supply in those days must have been rather different in character to that now obtaining, and on the other, the escape might be explicable on the same idea that was given to account for the freedom of Versailles from the disease when Sanarelli found water vibrios in the Versailles

water, which closely resembled the true cholera vibrio, and suggested specific immunisation. Another, but temporary, chance of pollution would have undoubtedly occurred from the workmen during the erection of the new filter beds.

Filtration. The old filter beds which were in action previously to 1911 were quite incapable of dealing with the amount of water which modern consumption entailed. The filtration and settling were quite perfect. Entomostraca and ctenodril worms were frequently to be found in the service water; and I observed that a Doulton filter on a service tap required cleansing every few days from the sludge which collected in order to get a normal flow from it. The filtration material consisted of the local gravels, but the output was far too great to allow any prolonged contact with the material.

The new filter beds which were installed in 1911 allow of more complete filtration and settling; at the same time they afford more opportunity for contact with and dissolution from the filtration material, which as heretofore consists of the local gravels. So that we have the two propositions, (1) better anti-bacterial filtration and (2) onset of thyroid derangement becoming concomitant. If it is assumed that some mineral constituent, which might be absorbed from the local gravels, is the cause or an adjuvant factor of the thyroid trouble, it might be inferred that the present treatment of the river water results in making it similar to the rural well waters by affording closer and longer contact with the local gravels. Two other differences may also be noted in respect to the changes: (1) that, as the river water was found to be slightly plumbisolvant, an artificial addition is made to increase its lime hardness, and (2) an electrically driven pumping mechanism has been installed. It is hardly likely that either of these alterations would have the undesirable effect.

In respect to pollution of the water as the cause of the goitre, there is the contradictory condition of less probability of pollution associated with apparently higher incidence of the disease. The evidence that has been put forward of the successful results of the use of autogenous vaccines is not at all conclusive for it can hardly be maintained that such widely different organisms as Staphylococci, spore bearing and "colon" bacilli could have one and the same *specific* effect; supposing that some other fallacy in observation may not have been toward, it would have to be inferred that the vaccines were contaminated by some unrecognised specific agent, which McCarrison believes to be an anaerobic bacillus.

Perhaps it might be well to contemplate the possibility of interaction between pollution and mineral constituents. By means of bacterial action insoluble substances in the soil may be brought to a soluble form. Thus some experiments in which fresh soil, to which carbohydrate (sugar or starch) was added and then allowed to ferment by the aid of its own bacteria, showed notably more (three-fold to five-fold) soluble potash, silica and phosphoric acid than did the fresh untreated soil. (Carbohydrate manuring and the rubbish

heap, H.E.D., *Gardener's Chronicle*, 1919, p. 91.) Thus it is probable that bacterial pollution may affect the dissolved mineral constituents of the water proceeding from a given soil.

PERIOD OF EXPOSURE TO THE CAUSATIVE NOXA.

In experimental endeavours to produce thyroid enlargement positive results have been noted in comparatively short periods; thus McCarrison observed enlargement in goats after 64 days' exposure to water filtered through contaminated earth. In the case of naturally acquired trouble probably the period between exposure and apparent onset would be much longer. So far as concerns Hereford, since the date of the first appearance of the goitre in the city is not knowable, it is hardly possible to make any assumption as to the probable period. Taking the case of the recruit (cited above) and supposing that the alterations in the water-supply were the origin of his trouble and that the ensuing changes in its constitution were continuously exhibited, it would appear that the exposure from 1911 to 1916 had been necessary to evoke the visible thyroid enlargement; naturally, however, changes would have been going on long before any visual effect had become manifest. McCarrison insists on changes in the finer anatomy of the organ without gross hypertrophy. Again it must not be lost to sight that during and since the war period there may have been some increase of susceptibility through limitations and alterations in the dietary. And such influence may have been both direct in affecting the actual nature and variety of food, and indirect in regard to the economies in fuel in its preparation, here, particularly, for instance in the making of tea the water may have not undergone so much boiling as in former times.

SUSCEPTIBILITY.

In any epidemic or endemic condition perhaps the most interesting part is the consideration of the reason why some individuals, though apparently equally exposed, escape disease altogether or only suffer in minor degree. In the case of bacterial infections, much can be explained by unsuspected specific immunity, and in some other conditions we now know that extraordinarily minute quantities of certain nutritional factors are able to produce gross effects; thus in beri-beri tiny quantities of certain constituents of the diet are able to make the nerves resist the unknown neurotropic poison, which the writer believes will eventually prove to be of bacterial origin.

In regard to the question of thyroid derangement, if the theory of an absorption of products from the intestine holds sway, the nature of the bacterial flora of the intestinal contents of a given individual may happen to be of prime importance whether in the direction of refractoriness or of susceptibility; also the good functioning of such organs as are ordinarily concerned in the destruction or elimination of noxious absorbed products, and thereby shelter or expose the thyroid to undue extent. Whilst this latter

thesis will also apply to a mineral causation of the goitre, quite as a fantastic chain one might put down: (1) the thyroid has been thought to be concerned with the calcium metabolism; (2) fluorides act as secondary protoplasmic poisons as decalcifiers and thus upset the calcium balance. But of course the evidence is too flimsy to use this more than as an illustration hypothetically.

Whilst environment is directly concerned, heredity may play an indirect part in the assumption of an absorption from the colon; a somatic inheritance of certain coils or disposition of gut or mesentery might make some individuals more susceptible to delayed movement and consequent greater absorption.

BIOLOGICAL ASPECT.

Perhaps one of the more interesting aspects of the matter is the biological one. Goitrous conditions whilst not necessarily going to the extreme of cretin production, are likely to have an effect on the mental development of the succeeding generation, and one would have thought that nature would prescribe some attempt at concealment where such a condition existed. However it would seem that fashion in dress is more potent, and leads the female population to expose their deficiency to the view.

CONCLUSION.

There are indications that the progressive increase of goitrous conditions, which Dr Morrison recorded in the country districts, has reached the city of Hereford. There is therefore a strong case for advocating an exhaustive investigation into the causes of the malady by enquiring into the local conditions so that a more generalised endemicity may be avoided. Already the county is in no enviable state in regard to its lunacy statistics, and unless some active remedial steps are taken without undue delay the outlook engenders pessimism.