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yield brilliant results, such as elbow-joint and shoulder joint. Other joint diseases in which expectant treatment failed he submitted to amputation. Compound fractures involving joints were treated boldly by excising more or less of the injured parts. In cases of elbow and ankle-joint experience showed it was best to remove largely so as to avoid tension.

But to open a joint when no wound existed and thus the injury was not compound, would have been thought an absolutely unwarrantable procedure. Even the slight incisions into joints required for removal of loose bodies or the securing of displaced semi-lunar cartilages were regarded as full of risk, and were generally done by valvular methods, or at two stages, so that the risk of air entering the joint might be minimised.

Antiseptic surgery has changed all this, and joints are opened, emptied, stitched up, and generally manipulated with as great freedom as success.

Gentlemen, I know well that I have just touched the fringe of a great question. A full discussion of surgical progress would require volumes. Enough now if a hint dropped here and there may give food for thought. Gratitude to the great ones of the past, who transmitted the torch of progress to our hands—well slight and giving light. Let us remember that the next generation will look back on our feeble efforts with the same complacent self-approval which we may find in ourselves when we criticise the surgery of the old generation.

Special Articles.

THE GEOGRAPHICAL DISTRIBUTION OF DISEASES.

From the earliest dawn of medicine the influence of air, water, and soil on health and disease has been recognised. As we all know, Hippocrates laid special stress on the necessity for studying geography and topography from the medical point of view. Although empiricism subsequently tended to obscure this most important phase of science, yet it was never quite lost sight of; climatology in connection with therapeutics being based on geographical knowledge and experience. Health stations all over the world are of very ancient date, and were the outcome of observations on conscious and unconscious experimentalism. For it was observed that certain spots were healthier than others, some of them proving peculiarly suitable for those unfortunate suffering from particular diseases. When climatology began to be looked upon as an important branch of medical science, the tracing of maladies to particular regions received a great impetus, and the isolated observations collected by many men, proving that certain diseases took their origin in particular spots, to remain there as endemic maladies, or burst their geographical bonds and spread in mysterious ways far and wide, began to be collated and the study systematised. But, undoubtedly, the most useful work of this kind has been accomplished by Mr. Alfred Haviland, who many years ago devoted much time to the difficult task of tracing out the prevalence of certain maladies in various districts of England and Wales, and then mapping out the "Geographical Distribution of Diseases."

Before venturing into the more detailed study of soils it will be necessary to briefly review the work done by Mr. Haviland, and his conclusions. Early in his investigations it became clear that geography and topography could not be studied alone, for the evidence of the influence of geology was strong and abundant.

In 1875, Mr. Haviland gave the result of his first investigations to the world in the form of a volume, accompanied by coloured maps, tracing out the incidence of the death-rate from certain specified diseases in the different localities of England and Wales. Taking heart disease and dropsy, cancer in females, and phthisis in females, he traced out their geographical distribution with the help of the de cornial supplements to the Registrar-General's annual reports. For registration purposes England and Wales are divided into eleven divisions, 44 registration counties (Wales being counted two only) and 625 registration districts. It was found that as early as the eleven divisions there was a considerable difference as regards the localisation of the above diseases. For instance, his heart disease map showed that those divisions which were most exposed to the access of sea-winds, owing to low fore-shores, broad estuaries, and the fact that the valleys run in the direction of the prevailing winds had the lowest death-rate. Those divisions included London, Eastern Counties, Yorkshire, North Western, and the whole of Wales. But those divisions which are shut in from the sea, the most midland (such as the South Midland and West Midland divisions) and those, which, though near or on the coast were sheltered by high precipitous cliffs, and have the course of their rivers running at right angles to the prevailing winds and tidal wave, suffered from the highest mortality of heart disease. Then, as regards cancer (among females) the localisation was found to be quite as marked, though materially differing from the above distribution. The most South Easterly group of divisions, characterised as comparatively low-laying, by the tertiary and more recent clays and other retentive soils, by fully-formed rivers such as the Thames, which periodically flood adjacent districts, showed high mortality. These divisions were London, South-Eastern Counties, South Midland Counties, and the Eastern Counties. On the other hand, the North-Western groups, including Monmouthshire, Wales, and North-Western Counties (including the Lake District), characterised by elevated land consisting of the oldest rocks, Cambrian, Silurian,
Carboniferous, Limestone, &c., where the rivers are not fully-formed and do not cause widespread or lasting floods, showed a low death-rate from this dread disease. An intermediate state of affairs was found to exist in the elevated divisions of the Northern Counties (including Cumberland and Westmoreland), Yorkshire, North-Midland, West-Midland, and the South-Western, which are characterized a geological formation of the older palaeozoic rocks flanked by the secondary rocks immediately to the South-East and East. We next come to phthisis (among females) which showed quite as marked, but again a varied geographical distribution. Those divisions which are exposed to the full and direct force of prevailing sea-winds show the highest mortality. These exposed divisions are Monmouthshire and Wales, North-Western Counties, Yorkshire, North-Midland, and the Eastern Counties. Comparatively low-lying counties which are protected from the full force of the winds, show a low mortality; these are the Northern Counties (Cumberland and Westmoreland), West Midland, South Midland, London, South-Eastern and South-Western.

All these characteristics of the geographical distribution of disease are still more strikingly manifest when the death-rates are analysed for counties and districts. And, as Mr. Haviland points out, there would be an immense gain if the units of division were much smaller and more scientific, that is, mapped out according to physical boundaries. As matters stand now, the analyses of death-rates for counties and districts are more or less vitiated for scientific purposes, owing to the divergent physical and geographical characteristics of the counties and districts, so that high and low, or intermediate death-rates overlap each other, and to a certain extent modify results. The data for the mapping out of the geographical distribution of disease was not based on small numbers, but on very considerable figures for the ten years' mortality. The estimated population of England and Wales between 1861-80 was 18,995,916. The total deaths from heart disease and dropsy for the same period were 295,978; from cancer (among females) 43,137; for phthisis (among females) 269,918. These numbers are sufficiently large to enable accurate calculations to be made.

Mr. Haviland, during these investigations, became more and more convinced of the important part played by geology in the influencing of disease localisation. He carried on his investigations and has recently given part of the results of his study of a second decennial period, 1861-70, which confirm the calculations based on the statistics for 1861-60. In some of the counties and districts there are slight differences, which are no doubt mainly accounted for by the migration and massing of the population and other social phenomena.

"In studying disease-distribution," says Mr. Haviland, in the second edition of his work, "we shall find that the river valleys are the chief means by which the largest communities have kept their atmospheres changed, and it will be evident that those winds lying in the direction of the most frequent or prevailing winds will enjoy the most complete renewal; and as it so happens that the course of the tidal wave on the west coast throughout, and on the east coast for nearly three-fourths of its extent, coincides with that of the prevailing winds, the consequent influx of waters up the river valleys twice in every twenty-four hours must contribute to the movement of the air in the valleys, and in times when winds do not blow up them must tend to mitigate the evils of still air." Some valleys, he points out, ran counter to the usual prevailing winds, and then the winds blow over them, such valleys are not natural ventilators. The mapping out of disease localisation goes to show that wherever facilities are greatest for changing air, there is the lowest mortality from heart disease, while pent up valleys show a high death-rate from this cause. Heart disease shows a high death-rate in twenty out of twenty-six of the inland counties, this is brought strikingly before us in Herefordshire, Berkshire, Derbyshire, and Wiltshire, where many villages lie in deep valleys which are well sheltered. The death-rate from heart disease for 1861-70 was for England and Wales 18 per 10,000 of the population.

In the Lake District to the windward it was only 11-91, and to leeward as high as 16-04. Let us take London as an example of distribution. As a whole the death-rate from heart disease and dropsy was found to be low for the decade 1861-70, and this withstanding its many hospitals, receiving patients from outside districts. Drawing a line from Highgate to Norwood separates London into a western and an eastern division. The eastern is exposed to sea winds and the mortality is low, below the average for England and Wales. In the western, which receives the wind after it has passed over the densely populated areas, shows a death-rate slightly above the average for the whole country. But these broad results can well bear being further split up. In the eastern district Greenwich and Woolwich has a comparatively high mortality, probably owing to the presence of soldiers and the large number of arsenal workmen, and to the fact that the streets mainly run at right angles to the natural ventilation currents. In the western district, Hampstead, Westminster, St. George, Hanover Square, and Kensington have a low mortality; this is owing to the high character of the situations, the large open spaces, heaths, parks, and squares, wide streets, and the gravelly description of soil, so as at Kensington, Hyde Park, and the Bagshot sand which caps the elevated ground at Hampstead.

As regards phthisis (tubercular diseases of the lungs) among females, we have seen that the death-rate distribution is generally the reversal of the heart disease death-rate. It is low in sheltered localities, high in elevated exposed positions, especially those swept by sea-winds. It is the bitter winds which seem to play havoc with those predisposed to or already suffering from phthisis. Mr. Haviland feels inclined to attribute this partly at least to the presence of ozone, which seems to have an irritating effect on the diseased lungs. We all know from long ages of observation that warm protected localities, such as some of the foreign watering resorts, Riviers, such as Bournemouth, Ventnor, and Barnmouth at home, are beneficial to consumptive patients.
In sheltered valleys protection is found from the too strong winds. Mr. Haviland says that even when a certain amount of soil dampness prevails there will be a lower mortality in such sheltered valleys than in valleys or on the hill-sides, even if dry and exposed to the full force of the winds. During the decennial period of 1851-60 the death-rate from phthisis for England and Wales (among females) was 27.74. During the next period of ten years (1861-70) it had dropped to 24.88. This considerable amelioration is interesting, as it coincides with increased sanitary activity and a period of agricultural drainage. As we have already seen the distribution of these deaths varied consider-
ably with locality. In Cumberland and the Lake District the law above enunciated was clearly defined. The exposed districts had a general high death-rate to phthisis. Towns to the windward side of the great transverse mountain ridge in the Lake District showed a high death-rate, whilst those on the leeward side had a low death-rate. But exposed towns on the leeward side, such as Cockermouth, had a high death-rate from this cause. "In fact, if we examine the contour map in conjunction with phthisis (females) we shall find that owing to the configuration of the valley system of the whole area, the death-rates have to be interpreted from the central and more protected districts to the peripheral or coastal and more exposed." London, as a whole, has a low mortality from this malady, which has by some authorities been styled the national disease, but this mortality is made up of very divergent materials. The social aspect of affairs comes in and strikingly complicates affairs. Thus, in over-crowded Chalres, St. Giles', Holborn, St. Mary-le-Bow, St. George's in the East, St. Saviour's, St. Olave's, and St. George's Southwark, the death-rate from tubercular lung troubles is decidedly high. It is also to be observed that some of these high mortality districts are the most exposed to the force of winds.

The study of the water-hed or rain-drainage areas, and the water-parting or rivers, is of great importance. Rivers are the natural drains as the valleys are the natural ventilators, consequently the depth, length, angles of slope, and nature of bed all have their significance, and so has their position as regards the direction of the prevailing winds. Then again, the rivers themselves differ widely. Some are slow, apt to overflow their banks and flood the neighbourhood, or when winding their sluggish way in low-lying districts help to keep the soil more or less damp. Moreover, the waters of these sluggish rivers are seldom very pure, being polluted either owing to the natural drainage of large extents of agricultural land, or by passing through crowded districts and being contaminated with town or trade refuse. Naturally, the flooding of land by such polluted waters increases the evil effects of the soaking of the soil. Other rivers are more impetuous, of a torrential nature, and these rarely flood the neighbourhood, and when they do the floods are not of long duration. These torrential rivers are found in, or arise in mountainous districts, and are generally found in such geological formations as the older paleozoic, carboniferous limestones, and the secondary rocks, such as the politic limestones and chalks. Lakes partake much of the same character. The waters of those in high lands are generally pure and sparkling, whilst the waters of low land lakes are generally similar to those in the sluggish rivers.

Cancer seems peculiarly influenced by this question of the nature of the water course and the character of the water. The facts brought out clearly by Mr. Haviland from the study of the Registrar-General's Decennial Supplementary Reports, both of 1851-60, and 1861-70, were:

(a) That the districts which had the lowest mortality among females from cancer were characterized geographically by the older (paleozoic) and most elevated rocks, such as the lower and upper Silurian and carboniferous limestones series; by the secondary (mesozoic) limestones; oolitic and chalk formations.

These low mortality districts were also found to contain the sources and upper tributaries of rivers, and were not subject to floods.

(b) That those districts which had the highest mortality from cancer among females were on the other hand characterized geologically by clays, such as the clay, the Kimeridge and Oxford of the clastics, the Wealden clay, the gault of the chalk formation, the London clay of the eocene, the basaltic clay of the pleistoceros of glacial period, and the boulder-earths and alluvial deposits of recent age. These high mortality districts were found to be traversed by fully-formed rivers that seasonally flooded their banks.

The Lake District has a low death-rate for cancer, but there are the usual minute differences. The highest mortality here, as elsewhere, is found in those districts through which the fully-formed river Eden runs, and the comparatively low ground of Penrith and Carlisle, characterised geologically by clays, alternations of shale and limestone with aluvial and other deposits of soil. London has the unenviable position of showing the highest mortality among females from cancer of all England and Wales. Mr. Haviland says that London may, broadly speaking, have three natural, geological formations, alluvium, drift gravel, and London clay, and two artificial formations, "made soil" and granite; this latter due to long and extensive macadamizing operations—the first of these artificial is bad, the second beneficial. The drift gravel varies greatly in the thickness of the bed, and lies over clay, so that the presence of gravel does not always mean much. Over the London clay on high ground there is generally silicious deposits. Hyde Park is nearly all gravel, but Regents Park and Primrose Hill are clay. Of the thirty-six London districts thirty have a death-rate above the average, and only six below. The latter favoured districts form a semi-circle, extending from St. Luke's through Edg. London, Bethnal Green, Poplar, Bethnal Green, and Bermondsey. All these, with the exception of Poplar are on gravel soils. Marylebone, including Regents Park and Primrose Hill, which area on basalt-drained clay, have the highest death-rate. Westminster, which includes
the high gravelly-soiled Kensington, shows a low mortality from this cause. Harrow, Hendon, and Wimpole, exposed to winds and with their Biggleswade soil, show a low death-rate; as do also Harrow, Wimbeldon, Blackheath, and Shooter's Hill. All of which are on high, exposed ground, with silicious earths under the London clay. A most remarkable table showing the influence of limestone and clay—on cancer mortality is given by our author. The general average death-rate for females for England and Wales during the period 1881-70 was 118 per 10,000, in the limestone districts it was 150.9, and in the chalk districts only 92.7. Does not this table throw much light on sanitary and local authorities as to vital importance of drainage and soil prevention or improvement?

Dean of Westminster, once addressed in the course of a discussion on the paper dealing with the drainage of Bristol, that "There is every reason for believing that "with the ancient city of Bristol was founded in drizzle, through the granite bedwomen would be delighted with their speculation. He could not help thinking that the absence of female beauty was not so remarkable as to have induced the passing of a law in the time of Queen Elizabeth granting the freedom of the city to any man who married a Bristol "woman," in some degree has been largely caused by disease of this organ. He had always observed that in damp air and bad situations, the human form was imperfectly developed, and that there was an absence of beauty. "Obstetric persons" will be more than inclined to endorse the theories thus put forward by so keen an observer as the Dean. Cretean and Goths are in undoubted association with bad sanitation in the dirty villages of pent-up valleys. "Goths," itself,—"Derbyshire neck,"—is unquestionably influenced by geology, as it is only engrafted in districts where the drinking water is heavily impregnated with salts of lime and magnesia, and where telluric mist prevails, which tends to lower the vital system and predisposes persons to this local disfiguring growth.

Cholera epidemics in England have always shown a tendency to localise themselves, generally proving most severe on low lying alluviums or at crowded stations. Of the nine thousand and odd recorded cases 4,198 occurred on the south side of the Thames, and 4,910 on the north side. This gave a percentage of 1 to every 283 persons on the north, and 3 to every 64 persons on the south side; the north side being generally high and wind swept, the south low and marshy. In 1849 there were 58,298 recorded deaths from cholera, or 55.6 of 46,592 which occurred in only 184 out of the 628 registration districts. A rule it was found that elevated spots were spared, while London and sea-port towns, on more or less alluvial or "made soil," suffered severely.

Before summing up I must give a few notes as to the geographical distribution of one or two other diseases of the decade 1861-70. The average death-rate from stomach and liver diseases was 10-02 for males, and 9-81 for females per 10,000 of the inhabitants of England and Wales. In the Cumberland and Lake Districts the mortality from these causes was generally below the average, though at Alston it was higher, reaching 14-42.

"Taken as a whole, the diseases of the digestive organs, having nothing specific about them, will be found to thrive in Great Britain, where the climate is relaxing, as in pent-up valley systems, and ill-adapted to fortify the body against the assaults of disease and injurious meat and drink."

"The death-rate from kidney diseases during the twenty year period, 1861-70, was for males 9-71, and for females 1-60 per 10,000. These organs are very delicate and sensitive to climatic changes; kidney disorders following on other diseases, when vitality is low, or on bad chills. In the Cumberland District this seems to be demonstrated, for the deaths from these causes were slightly above the average at Penrith, Carlisle, Cockermouth and Kendal."

"Child-birth and Metzir give a peculiarly varied mortality according to locality, and it is more than probable that soil-pollution and consequent noxious telluric effluvia have a decided influence. Topography, therefore, is also likely to play an important part in this matter, both as regards attitude, aspect, water distribution, and geological formation."

I have endeavoured to show that in the study of disease as influenced by climate, phenomena and geology, physical geography must also be taken into consideration. In this article I am mainly indebted for the facts brought forward to Mr. Haviland's work, which gives a thorough sketch of the medical aspect of the physical geography and geology of our country. As our author says, the study of the subject shows that no one predisposed to certain diseases should be sent to live in given localities. The man who suffers from, or is likely to fall a victim to consumption, must not be sent "where he would be subject to the full force of prevailing winds. Or one dreading rheumatism and heart disease into an unventilated pent up valley, where the mortality from cardiac affections is high. Nor should we send the offspring of cancerous parents to reside, either for education or earning their livelihood, in low-lying, clayey, flooded districts!"