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Lectures

ON

THE DISORDERS RESULTING FROM
DEFECTIVE NUTRIMENT.

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(From the London Medical Gazette.)



THERE is no subject of more interest to the physiologist, of more practical importance to the physician, or that more urgently demands the grave consideration of the statesman, than the disorders resulting from defective nutriment. Yet, with all its interest, and with its vast social importance, it is a subject which, until lately, has engaged but little steady attention. Large numbers of men at sea, and in our prisons and asylums, have, at various times, been kept on a diet insufficient in quantity and variety for the support of the body—diseases of strange kind have appeared among them—the cause has been recognized, and the remedy applied, in the individual case, but the lesson has been forgotten—mankind in general have been no gainers—and at a short interval of time, and in a different place, a knowledge of the imperious necessity of nutriment more abundant or more varied is again dearly bought by the experience of wholesale sickness and death.

Of late, the attention of some of our most eminent physiologists has been directed towards this subject, and their experiments have led to many striking and unexpected results: but those experiments have been performed on the lower animals, and we are still but imperfectly acquainted with the various disorders that result from deficient nutriment in man. These disorders are, no doubt, frequently presented to us by the destitute poor in our large towns; but from their occurring in a scattered manner, and from our not being acquainted with all the circumstances in which they arise, their real cause escapes us. It is only—as in ships, garrisons, prisons, and asylums—when large numbers of men, with the daily routine of whose life we are acquainted, become affected with one disease, that our attention is fixed upon it, and that we can succeed in discovering its cause by considering what is peculiar in the circumstances in which the sufferers have been placed.

There are three different forms of disease, which are already traced to defective nutriment. The first and best known of these is scurvy, properly so called; of the second, the most distinctive character is a peculiar ulceration of the cornea; the third is chiefly marked by softness, or imperfect development of the bones. There is perhaps a fourth, whose most striking symptom is diarrhoea. These diseases are not only different in appearance, but they arise from different causes—the defect or error of diet, on which they depend, is different for each—

and any one of them may occur quite independently of the rest.

The chief indications of scurvy are, a pallid and somewhat dusky complexion; spongy and livid gums; and a remarkable proneness to hemorrhage, which shows itself in bleedings from the nose and gums, in discharges of blood from the stomach and bowels, and in petechiæ and large ecchymoses on the skin.

The lividity and swelling of the gums, which form perhaps the most striking character of scurvy, appear first at their free edges, but gradually extend until, in some cases, the gums are converted into a black, spongy mass, bleeding at the slightest touch, and completely concealing the teeth. This remarkable change of texture is strictly limited to the gums. The tongue is clean, and moist, and pale; and the inside of the lips and cheeks, smooth and pallid, as in chlorosis, and in striking contrast to the livid and spongy gums. When the gums are much affected the teeth become loosened in their sockets, and they not unfrequently drop out without having suffered decay.

The ecchymoses on the skin appear first, and are always in greatest number, on the legs; from the influence, no doubt, of gravitation. In advanced stages of the disease they are often seen on the arms and trunk; but very rarely on the face or head. They occur in small, circular, petechial spots, and in large irregular spots, of a variegated violet and green tint, which resemble in every respect the marks of a severe bruise.

In addition to these symptoms, we not unfrequently find the calf, or ham, hard and brawny, and the knee contracted, from an effusion of blood between layers of muscles, or in the deep-seated cellular tissue.

The effects of scurvy, as of other diseases which depend on an altered state of the blood, are usually first seen in parts that have been previously injured. The bruise-like marks on the legs often surround an old scar, or appear on a part that a long time previously had been the seat of some injury. In some cases, in advanced stages of scurvy, wounds long healed break out afresh; and fragments of bone consolidated after fracture become again disunited. But, notwithstanding this, there is very little disposition to ulceration in parts that have not previously been ulcerated. I have never met with ulcers of the cornea in a scorbutic patient; and although I have often had to treat sailors who had been confined to their hammocks six or eight weeks in a high

degree of scurvy, and during that time had been scarce able to change their posture, from the pain occasioned by any attempt to move the legs, I have never met with a single instance of bed-sores.

The natural secretions, in scurvy, are usually scanty. The skin is dry and rough; the urine in most cases, at least in sailors, is high coloured and scanty; and the bowels are generally confined. The patient may, indeed, have an occasional liquid and fetid stool, consisting chiefly of altered blood; but in simple scurvy the bowels are habitually costive. I have frequently met with instances of sailors in the most advanced stages of scurvy, when, from the state of their gums, they could eat but little of their hard provisions, passing seven or eight days without any evacuation from the bowels. In this respect, and in the absence of any especial tendency to ulceration, scurvy offers a striking contrast to other forms of disease induced by insufficient nutriment.

The outward signs of scurvy—the spongy and livid gums, the petechiæ or bruise-marks on the legs, the pallid and dusky complexion—are, from the first, attended by lowness of spirits, and, as might have been expected, by great muscular debility. There is, too, a great tendency to syncope, which, in advanced stages of the disease, is brought on by change of posture or any trifling exertion, and which not unfrequently proves fatal. But there are no striking nervous symptoms: the intellect is unaffected, and the senses are clear, to the last.

What would scarcely have been expected, the highest degree of scurvy may exist without much emaciation. I have, indeed, met with an instance of scurvy proving fatal without any perceptible loss of flesh. In this respect the disease may be compared to chlorosis, in which there may be very little wasting, when, from the impoverished state of her blood, the patient is reduced to extreme weakness. Sailors, when brought into hospital far advanced in scurvy, are generally, however, much emaciated; in consequence, perhaps, of their having had nothing to eat for weeks but hard salt-beef and ship-biscuit, which they are unable to masticate from the state of their gums.

Another circumstance that cannot fail to have struck every one who has seen much of scurvy, as it occurs at sea, is the remarkable uniformity of its character. The same symptoms, or nearly the same symptoms, are present in all. From this we may infer, when we find scorbutic persons affected with diarrhoea and other symptoms not usually associated with scurvy, that some cause has been in operation besides that by which scurvy is usually produced.

If, now, we inquire into the circumstances under which scurvy arises, with the view

of ascertaining its cause, we find that the only condition which is never wanting, and which seems absolutely essential to its production, is complete and prolonged abstinence from succulent vegetables or fruits, or their preserved juices, as articles of food.

The disease, which, until the performance of long voyages was almost unknown in the South of Europe, where vegetables and fruits abound, was, on the contrary, endemic, and the cause of great suffering, in all the northern countries, in the earliest times of which we have any medical record. In the sixteenth century, the Swedish and Danish physicians published very accurate accounts of its symptoms, and recommended, as preventives and remedies, various succulent vegetables—especially scurvy-grass, brook-lime, and water-cresses—which are found native, and in great abundance, during the summer months, in high northern latitudes.

All those writers agree, that the latter part of winter and the early part of spring was the season in which scurvy prevailed most, and that it uniformly disappeared during summer and autumn; but that, although endemic during the spring of every year, it was after winters unusually severe, or when the country had been laid waste by war, and during long sieges, that its ravages were most severely felt.

As agriculture and gardening improved, scurvy gradually became less frequent, and now that by the influence of these arts succulent vegetables are grown in such plenty as to form an important part of the food, even of the lowest of the people, in the most inclement season of the year—and that by the activity of modern commerce, and the rapidity of modern intercourse, the fruits of tropical climates supply the table during the dreary winters of the north,—the disease hardly ever occurs on land, except during sieges, or in persons long shut up in prisons and asylums. It would, indeed, have long ceased to attract attention if our improvements in navigation had not led to the performance of long voyages. By this scurvy was perpetuated as a formidable disease, destroying great numbers of men, impeding our commerce, and causing great loss, and occasionally national alarm and danger by almost disabling our fleets, long after it had ceased to occur on land, except after protracted winters, or during sieges, or among the then neglected inmates of our prisons and asylums.

The circumstance of its rarely occurring except at sea, has led many modern writers into the error of considering it peculiar to sea-faring people, or, at least, to regard what they have termed *sea-scurvy* as different from scurvy arising on land; but reference to the writers of the 16th and 17th centuries,

the accounts of the siege of Alexandria in the late war, published by Baron Larrey, and the reports of the Inspectors of Prisons, show that the disease may be equally destructive on shore, and that it presents there precisely the same characters as at sea.

The ravages occasioned by scurvy at sea during the voyages of the early navigators almost surpass belief; and must increase our admiration of the perseverance and courage that, unsubdued by such difficulties, still pushed on, with instruments we should now consider imperfect, over the unexplored expanse of ocean.

Vasco de Gama, in the voyage in 1497, which had such a remarkable influence on the destinies of this country, and of Europe, by the discovery of a passage to the East Indies round the Cape of Good Hope, lost a hundred of his men, out of a hundred and sixty, from this distemper.

In the expedition for the establishment of the East India Company, consisting of four ships under Commodore Lancaster, which left this country on the 2d of April, 1600, scurvy prevailed to such a degree in three of the ships, that one-fourth of the crews died of it before reaching the Cape, and the rest were so weakened that hands were wanting to work the ships, and the merchants on board were obliged to do the duties of common sailors. A remarkable circumstance was here noticed, which, if laid hold of and turned to profit, would have prevented many subsequent disasters. It was, that while three of the ships were so weakened by scurvy that their crews could not take in their sails or hoist out their boats, the Commodore's own ship was in perfect health. This was attributed at the time to his having given three table-spoonfuls of lemon-juice every morning to each of his men. The discovery of the virtues of lemon-juice, as a preventive of scurvy at sea, seemed to have been made; but it was soon forgotten, or, at least, it was only remembered when chance again offered some striking proof of the singular efficacy of oranges or lemons. No practical advantage followed; the disease continued, as before, to devastate our fleets, destroying more men, even in time of war, than fell in battle, until 1795, when attention having been again called to the protective influence of lemon-juice, and some experiments having been made which left no doubt of its reality, an Admiralty order was given that every ship in His Majesty's navy should have a regular supply of it. The effect of this order was remarkable. Notwithstanding the improvements that had been made some years previously in the victualling and general management of our ships, and which had done much to improve the health of sailors, the mortality fell sud-

denly, and to a degree that can scarcely be credited by one who has not read the heart-rending accounts of the sufferings occasioned by scurvy in the voyages of Lord Anson, and our earlier navigators. Some estimate may, however, be formed of the effects of this and of the other salutary measures, by a fact mentioned by Sir J. Barrow, that between the years 1779 and 1813 the ordinary sickness and mortality in the British navy were reduced almost to one-fourth of their former proportion.

At present, scurvy is almost unknown in the British navy; and our ships of war, while on the ocean, often have a less mortality than the most healthful districts of the globe. This is what might have been expected from the pure air at sea, and the freedom from noxious malaria and contagious diseases that occasion so large a share of the mortality on shore, and from the absence of the cares and anxieties that exercises their corroding power on those whom necessity compels to earn a precarious subsistence in the crowded workshops of our manufacturing towns.

Now that the experience of nearly half a century has established the infallible efficacy of lemon-juice in preventing scurvy even in the longest voyages, and in curing it in whatever circumstances it occurs, and when lemon-juice is so cheap that a sailor may be furnished during a voyage from this country to Calcutta with the liberal allowance of the navy for four or five shillings, it may well excite surprise that up to the present time no regulation has been made for compelling our merchant-ships to take a supply of it. Our merchant-seamen, of whose great importance every statesman is aware, who enrich the country in peace and defend it in war, are still left to the avarice of ship-owners, who not unfrequently sacrifice the health of the crews, and often, by a just retribution, their own interest, for a petty saving of what, at sea, must be considered one of the necessaries of life. Every year a number of miserable beings are brought into port in our merchant-ships, with pallid sallow countenances, with their bodies mottled with petechiæ and bruise-marks—their gums bleeding and spongy—their teeth dropping out—as if to show us the fidelity of the descriptions which the old navigators have left of their sufferings, to bring the past in contact with the present, and to teach us a lesson of humility by showing, with all our boasted improvements, how slow we still are, when not urged on by the impulse of self-interest, in giving effect to discoveries most important to the well-being of our fellow men. Now and then still worse cases occur. A vessel in a voyage from Sidney, or from the Mauritius, loses half her crew

of scurvy; the rest, with the exception of the officers, who, from having a more varied diet, escape, are brought into hospital in the condition I have described; but no notice is taken of the fact. The owners get a fresh crew, and the vessel again puts to sea—we may hope, for the sake of humanity, better provisioned than before. Occasionally, one or two of the debilitated wretches die suddenly of faintness, brought on by the exertion of being moved from their vessel to the hospital, or to lodgings on shore. A coroner's inquest is held, and the want of all antiscorbutics proved; but the complaint is ascribed to contagion, to the close state of the fore-castle, to salt provisions—to any cause but the right—and the inquiry ends by a rebuke from the coroner. No indignation is excited that valuable lives should be so shamefully sacrificed, and that so much suffering should be endured, which, as the experience of half a century has proved beyond dispute, the expense of a few shillings would have prevented.

But astonishing and humiliating as all this is, it is yet more astonishing that scurvy should still prevail in our prisons, where it might be prevented with certainty by any of the cheapest and most abundant of our succulent vegetables; which experience has shewn to be just as efficacious as lemon-juice. Such, however, is the fact. The reports of the Inspectors of Prisons, published by authority of parliament, since the year 1836, abound with instances of the occurrence of scurvy in our jails and prisons. In the first report it is stated that, in 1836, it assumed a very malignant form in the county gaol at Norwich; no fewer than eighteen persons being severely affected with it. It is also stated in the same report that, in the House of Correction at Swaffham, the prisoners frequently lose their teeth by the effect of scurvy; and when they were examined in the presence of the Inspector, sixteen were found presenting its early symptoms. The late reports show that it has not become much less frequent since.

I can only explain the numerous instances of scurvy in gaols in different parts of the kingdom, by the fact, that mistaken notions as to its cause are still very generally entertained by medical men.

The continued prevalence of the disease at sea, long after it had ceased to excite much attention on shore, led to the notion, which is not yet fully exploded, that it is occasioned by the excessive use of salt.

The occurrence of scurvy in our prisons, where salt meat, if given at all, forms a very inconsiderable share of the diet, is, perhaps, a sufficient refutation of it. But if further evidence be necessary, it is found in abundance in isolated cases scattered through our medical journals and Transactions, and in the

accounts left us by the physicians of the 16th and 17th centuries, of the ravages of scurvy on land. In 1720, during the war between the Austrians and Turks, when the imperial army wintered in Hungary, many thousands of the common soldiers were cut off by scurvy. Dr. Kramer, who was physician to the army, tells us that the soldiers ate no salt beef or pork; but, on the contrary, had plenty of fresh provisions, at a very low price. The disease, he says, broke out at the end of winter, and, notwithstanding the prescriptions of the College of Physicians at Vienna, to whom he had applied for advice, it persisted until, on the approach of summer, the earth became covered with vegetables and fruits. In the early part of last century scurvy was also very common and very fatal in the Russian armies, although the soldiers had no salt provisions.

No longer ago than 1836 it prevailed to a great extent among our troops stationed in the new province of Queen Adelaide at the Cape of Good Hope. It appears from the report of Dr. Murray, the principal medical officer at the Cape, that the men had no harassing duties, and were abundantly supplied with good fresh meat, without having had an ounce of salt provisions; but they had been a long time without fruit or fresh vegetables. It is interesting to remark that the disease appeared first about the end of July, and continued to prevail from that time to December; a season corresponding to spring in the northern hemisphere. In this circumstance, and in the fact mentioned by Dr. Murray, that none of the officers were affected, we find perfect agreement with many of the accounts left us of the occurrence of scurvy in the continental armies in the early part of last century.

These instances, and I might bring forward many others of the same kind, are sufficient to show that scurvy may occur in the highest degree in persons living entirely on fresh meat. There are other facts which show that salt has no share whatever in producing it. It was long ago remarked by Dr. Lind, who had the merit of first pointing out the error of the opinion in question, that few workmen, in any business, are so healthy as those engaged in the preparation of sea-salt; and that persons who work night and day in the salt-mines in Poland, and even live in them, are not at all subject to scurvy; but, on the contrary, are remarkable for their health. It was remarked, too, by Dr. Lind, Sir G. Blane, and other of our naval physicians, that the drinking of salt water has no tendency to bring on, or to aggravate, scurvy. But another circumstance decisive of the question, as I think, is, that scurvy is not only infallibly prevented, but is cured with the greatest readiness, by lemon-juice, *even while*

the patients continue to subsist on salt provisions.

All these circumstances—that scurvy may exist in the highest degree in persons living entirely on fresh meat; that it is not increased by the use of salt; that it may be prevented, for any length of time, in persons who subsist on salt provisions, and can be readily cured, even in those who continue the use of them—show clearly that salt has no share whatever in producing it. That the notion is still held, and that it still exerts its baneful influence in diverting attention from the real cause of scurvy, and, consequently, blinding men to the means by which it may be prevented—a century after a clear refutation of it had been given by Dr. Lind, who, from being at the head of the medical department of the navy, spoke with a voice of authority in such matters—furnishes us with a striking instance of the difficulty of eradicating popular errors, even when their evil consequences present themselves in obvious and tangible shape.

The performance of long voyages, which perpetuated scurvy, and led to the error that it is produced by the excessive use of salt, by a kind of compensation gave the means of refuting the ancient opinion which the prevalence of scurvy in northern countries only had sanctioned; namely, that cold has a great share in producing it. When men began to make long sea-voyages, they soon found, to their surprise and dismay, that scurvy is no respecter of climates; that it may prove as destructive under the burning sun of the tropics, as in the icy seas of the frigid zone. An attentive consideration of the circumstances under which scurvy occurred on land would have led to the conclusion that cold has little share in producing it. It invariably attained its greatest height, not in the depth of winter, when the cold is greatest, but in spring. In some celebrated sieges undertaken in spring, and carried on during the summer, scurvy prevailed to an almost unexampled extent. During the siege of Thorn, in Prussia, by the Swedes, in 1703, which was carried on during the heat of summer, and lasted only five months, 5000 of the garrison, besides great numbers of the inhabitants, died of scurvy. Its independence of climate was shown by the fact that the besiegers were, at the same time, quite free from it. Another instance of the same kind, the latest on record, happened in 1801, during the siege of Alexandria. The siege, which was commenced by the English in May, lasted only to the end of August, yet no less than 3500 scorbutic patients were received into the military hospitals, which the French had established in the city. Among the inhabitants the disease was equally prevalent.

Instances of this kind occasionally happened to stagger men's belief, but they weighed little against the fact constantly presented to their notice, that the disease prevailed exclusively in northern countries and that it was invariably most felt after winters of unusual severity, and the notion still held its ground that the direct influence of cold has great share in causing it.

Men had not yet perceived that the disease had its real origin, not in the cold of our rigorous climate, but in the abstinence from fresh vegetables and fruits, which, in the infancy of our agriculture and commerce, the cold of winter always occasioned.

Another circumstance that made men more slow to seize on the real cause of scurvy, is, that the disease only appears after the cause has long continued to act. Abstinence from succulent vegetables or fruits, or the preserved juices, which we may consider as their equivalent, produces no ill effects at first. It is only after this abstinence has been protracted from two to five months that the health suffers so grievously. This explains the fact that the disease, when occurring in ordinary circumstances on land, invariably appeared, not at the beginning or in the depth of winter, but towards the end of winter or in spring. It explains, also, another fact, not noticed by medical writers, but which clearly appears in the history of scurvy, that the fatal effects of scurvy were most felt during sieges commenced in spring, and in voyages entered on in spring from cold countries. The siege and the voyage prolonged, not the cold of winter, but the abstinence from succulent vegetables and fruits. Another exemplification of the same law is seen in the reports of the Inspectors of Prisons. It is frequently stated in the reports, that scurvy shows itself first, and always exists in the highest degree, in the prisoners longest confined. Scurvy has often prevailed in lunatic asylums, and to a greater degree than in other establishments, where the diet is in no respect better; and many persons have in consequence inferred that lunatics are especially prone to scurvy. The fact is fully accounted for by the very long time these unfortunate persons are kept in confinement. The defect of diet, which does not show itself in a few weeks, or perhaps, months, becomes manifest enough after the lapse of years.

Want of the insight which this idea gives us, compelled physicians to have recourse to a great variety of causes, in order to explain what appeared to them anomalies in the history of scurvy.

Dr. Lind tells us, that while he was surgeon of the *Salisbury*, in 1746 and 1747, scurvy raged with great violence in that ship during two Channel cruises, one of ten

weeks, the other of eleven; and that in each of these cruises it shewed itself in less than six weeks after they put to sea: yet in a subsequent cruise of *twelve* weeks, which was the longest the *Salisbury* made, there was but one scorbutic person on board. Dr. Lind could assign no cause for this difference except the state of the weather. The real cause is, undoubtedly, to be found in the circumstance, that the two first cruises were made in the months of April, May, and June, so that she left port in spring; while the last was performed in the months of August, September, and October.

It was long brought forward as a strong argument in favour of the great influence ascribed to cold in the production of scurvy, that the sailors who suffered most from it were those engaged in the northern whale-fishery; although the vessels employed in this service were better provisioned than any others, the voyage from this country short, and the men kept constantly in action. The fact was unnoticed—that these vessels always leave this country in spring.

The history of our navy abounds with instances showing that scurvy is not produced by the use of salt, by cold, or by the various other influences to which it has been vaguely ascribed, but imply by prolonged abstinence from succulent vegetables and fruits. A very instructive instance, the last the annals of our navy furnish, occurred in the channel fleet, under the command of Lord Howe, in the spring and summer of 1795; a year ever memorable for the complete extinction of scurvy in our navy by the introduction of lemon-juice as a regular article of diet.

The winter of 1794-5 was long remembered for its severity, and the distress it occasioned by the destruction of vegetation. In the beginning of April scurvy made its appearance in the Channel fleet, and soon spread to such an extent as to endanger the safety of the whole fleet. Its speedy suppression became an object of national concern, and every effort was made by the Admiralty to effect it. The men were furnished with fresh meat, and with a plentiful supply of oranges and lemons. Vegetables, at first, could be procured only in small quantities. As the season advanced, they grew more plentiful, and after the 31st of May, 5000 weight of salad was distributed daily among the ships at Spithead.

The good effects of this change of diet were astonishing; and on the 12th of June the squadron sailed in good health. Scurvy, however, made its appearance again, but it was found, from the list of patients, that during the cruise, which was a long one, *not a man who had shared in the allowance at Spithead had the slightest recurrence of it.*

The scarcity of vegetables, consequent on

the unusual severity of the winter of 1794, brought the diet of the poor in our large towns nearly to what it was before the succulent vegetables, which now form so important a part of the food of the people, were introduced into this country; and, as happened in the olden time, scurvy showed itself among them during the spring months. In the spring of 1795, well-marked cases of scurvy were introduced into most of the London hospitals; and Dr. Heberden has left a good account of some that were under his own care in St. George's. Speaking of one of these patients, he says, "His diet, previously to the occurrence of scurvy, consisted of bread and butter, with tea, for breakfast; fresh meat and bread for dinner; and water-gruel for supper. This was his common food at all times, excepting that he had been used to eat vegetables, which, on account of their high price, he had not been able to procure for some months."

Another cause to which men had recourse, in their inability to explain the anomalies of scurvy—that in some voyages it appeared in a few weeks, in others only after as many months—is defective ventilation and want of cleanliness. No doubt, free ventilation and cleanliness contribute much to health, by furnishing a constant supply of the first necessary of life; and want of them greatly increases sickness and mortality in our large towns, by favouring the spread of infectious diseases; but it is equally clear that it has no influence, at least no direct influence, in causing scurvy.

The narrator of Lord Anson's voyage tells us that during the latter part of their run, before their arrival at the island of Tinian—the part of the voyage in which scurvy proved most destructive—all the ports were kept open, and uncommon pains taken to sweeten and cleanse the ship, without producing any abatement in the progress or the virulence of the disease.

Dr. Trotter, in his admirable account of the health of the Channel Fleet, in 1795, from which I have already borrowed, says: "To have thought of foul air as a cause of scurvy, when it appeared in the *Royal George* and *Queen*, would have been the last resource of a physician investigating causes, who had witnessed the admirable system of duty practised by Captains Domet and Bedford."

The fact, that scurvy is at present never met with in the most crowded and filthy parts of the metropolis, affords additional proof that defective ventilation and want of cleanliness have no direct influence in causing it.

But medical writers have been slow to perceive the full force of these facts, and to admit, what the history of the disease incontrovertibly proves, that scurvy is the effect of

deficient nutriment only; and that cold, defective ventilation, and the various causes assigned for it, have no other influence than in so far as they waste the body or impair nutrition.

The time during which abstinence from succulent vegetables must be continued in order to produce scurvy, varies, as I have before remarked, according to the nature of the food on which the person has been living. The disease showed itself earlier in the voyages undertaken in spring, when the men for some time had eaten sparingly of vegetables, than in voyages commenced at the end of summer, when vegetables and fruits had been for some time abundant. The element, whatever it be, which the vegetable juices furnish, and which is the true preventive of scurvy, is expended slowly. The better a person has been supplied with it, the longer he can subsist without it. We have an analogous fact in the prolonged abstinence from food that animals which have much fat can maintain. The fat is slowly consumed in fuel for the respiration and animal heat.

As might have been expected, scurvy shows itself sooner, under the same diet, in persons reduced by other illness. In the Channel Fleet, in the spring of 1795, scurvy appeared chiefly in those men who were convalescent from an epidemic catarrh; and during the siege of Alexandria in 1801, those soldiers who had received severe injuries, or were reduced by the ophthalmia, which at that time prevailed among them, were the first to suffer from it.

It has often been observed to affect in an especial manner persons recovering from intermittent fevers; and there can be little doubt that losses of blood, debilitating medicines, or any illness that wastes the body, would have a similar tendency, and hasten the appearance of scurvy.

The periods of life, too—that of growth, when the demand for nourishment is great, and that of decline, when the powers of reparation are feeble—are those in which scurvy shows itself the soonest. It appears, from the registers of the Dreadnought, that persons between the ages of 20 and 30 are the least liable to scurvy; and that above the age of 30 the disposition to it continually increases with age.

The whole may be summed up in this—that scurvy, in common no doubt with all diseases that result from deficient nutriment, shows itself soonest in young persons, and in persons wasted by losses of blood, by great bodily exertion or by illness, and in persons in whom, from age or any other cause, the assimilating powers are weak.

A remarkable circumstance in the history of scurvy is the rapidity with which recovery takes place, when the patient is freely supplied with oranges or lemons, or almost any fresh

succulent vegetables or fruits. In the course of a few days only, the complexion loses its sallow and dusky hue; the gums become firm and florid; the effusions of blood on the skin and between the muscles disappear; the despondency and muscular weakness give place to cheerfulness and a feeling of strength—every thing betokens the rapid return of health.

The recovery is not only rapid, but it is complete. The disease, however severe, does no permanent harm to the constitution. In this respect scurvy offers a striking contrast to other diseases produced by deficient nutriment.

The circumstances under which the disease occurs, the symptoms which mark its presence,—especially the dusky hue of the complexion, the spongy state of the gums, and the great proneness to hæmorrhage,—and the absence of any special lesion of the solids discoverable after death, leave no doubt that a faulty state of the blood is the source of all the symptoms. The food is deficient in necessary constituents, and the blood formed from it is imperfect. A circumstance which shows that the morbid change of the blood in scurvy is of a *special* kind, is, that even in persons labouring under other and fatal diseases, the symptoms of scurvy rapidly disappear under the use of lemon-juice. I have witnessed several instances of this, but none more remarkable than in a man who was admitted into the Dreadnought in a high degree of scurvy, and affected at the same time with dropsy from granular kidney. Notwithstanding the latter disease, the disappearance of the scorbutic symptoms, after he was freely supplied with oranges, was as rapid as I have ever seen it.

The question now naturally occurs, what is the nature of the morbid change in the blood, which constitutes scurvy?

It was held by early writers on scurvy that the blood in this disease is loose and dissolved; and the same idea has been repeated by the most distinguished of our modern physiologists, who have stated in more precise language that the globules are dissolved in the serum. Such, however, is not the case. The serum is not tinged with the colouring matter of the blood. Even in advanced stages of scurvy, the blood separates into serum and clot as rapidly and as perfectly as healthy blood; and in some cases the clot is very firm, and much buffed and cupped—the consequence, perhaps, of a diminished proportion of the globules to the fibrine.

The result of some analyses of scurvy-blood, made for me by my friend Mr. Busk, shows that the proportion of hematosine is much diminished, while that of the fibrine, of the albumen, and of the salts, is increased. The diminished proportion of hematosine, or

of the globules, might have been inferred, without any analysis of the blood, from the general paleness of the tissues; and it affords a satisfactory explanation of the tendency to swoon, so constantly observed in scurvy; for physiologists have shown that the vivifying influence of blood on the nervous system is mainly due to the globules. But a diminished proportion of globules affords no explanation of the spongy state of the gums and the great tendency to hæmorrhage; for those symptoms are not met with in chlorosis, in the advanced stage of granular kidney, and other diseases, in which the proportion of globules is likewise diminished. On the contrary, it appears from the researches of MM. Andral and Gavarret, that in most diseases in which there is a marked tendency to hæmorrhage, the chief peculiarity of the blood is an excess of globules. The change of the blood that constitutes scurvy must, then, be of more special kind than a mere diminution of globules.

This change cannot consist in diminution of albumen or fibrine, for analysis shows that no such diminution exists. Besides, in granular kidney, the blood is often much drained of its albumen without producing any scorbutic symptoms.

If, as the origin of the disease seems to show, the fault of scurvy-blood is deficiency of some of its constituents, the most probable supposition is, that this deficiency is in the salts; that some saline principle, small perhaps in amount, but important in agency, and necessary for the nutrition of some tissues, is wanting. The tissue that seems to suffer most is that of the small blood-vessels, which become weak and easily ruptured. The spongy state of the gums, the fungoid granulations of ulcers, the hæmorrhage that takes place in the lower extremities, where the vessels are exposed to additional pressure from the gravitation of the blood, may perhaps be explained by defective nutrition of the small vessels. The hair, the nails, the transparent cornea—parts that suffer in animals kept on a diet deficient in nitrogen—are not affected in scurvy. The hair does not fall off the cornea does not lose its transparency.

We have another clue to the principle wanting in scurvy-blood, by considering the source from which it may be restored; namely, the succulent juices of vegetables and fruits. These juices—the preventives and specific remedies of scurvy—contain albumen, fibrine, and organic acids in combination with inorganic bases. Their virtues cannot depend on their albumen or fibrine, because these are in excess, rather than default, in scurvy-blood. They must depend on some of the incidental principles with which the albumen and fibrine are associated. The radical importance of such principles, both

in plants and animals, has been well shown of late by Prout, Liebig, and other chemists, and might have been inferred from the constancy of their presence, and from the fixed proportion which certain of them bear to the other constituents of particular tissues.

The principle, whatever it be, is common to the juices of a great variety of vegetables and unripe fruits; and seems to reside in the juices of the plant only. All vegetables and fruits noted for their antiscorbutic properties are very succulent; while vegetables, and fruits that are dry or farinaceous, have very little power in preventing scurvy. The process of drying seems indeed to destroy the antiscorbutic properties in plants which have them in the highest degree. Kramer tells us that he tried a great variety of dried plants to no purpose; and that, when scurvy prevailed in the imperial army in Hungary, in 1720, a large supply of the most approved antiscorbutic herbs, dried, were sent there by the College of Physicians at Vienna, but they proved of no service.

The antiscorbutic property seems to be impaired by the action of a strong heat. All men who have had much experience in the treatment of scurvy maintain, that the antiscorbutic virtue of vegetables is greatest when they are eaten raw; and that herbs in the form of salads are more efficacious than when boiled, or in any way prepared by heat.

Dr. Lind recommended that lemon-juice should be taken to sea, in form of a *rob*, made by evaporating the juice, by a slow heat, to the consistence of thick syrup. It was extensively tried, but found very inferior in efficacy to the fresh fruit. In consequence of this, Sir G. Blane recommended that the juice should be preserved by the addition of a small quantity of spirit, without the aid of heat; a plan now generally adopted. Juice so prepared seems equally efficacious with the fresh fruit.

The antiscorbutic properties of some fruits seem also to vary with the degree of maturity. Dr. Trotter says, that having observed scorbutic slaves throw away ripe guavas, while they devoured green ones with much avidity, he resolved to try if there was any difference in their effects. For this purpose he selected nine blacks affected with scurvy in nearly equal degree. To three he gave limes, to three green guavas, and to three ripe guavas. They were kept under the half-deck, and served by himself two or three times a day. They lived in this manner for a week; at the end of which, those restricted to ripe guavas were in much the same state as before the experiment, while the others were almost well.

The process of vinous fermentation seems also to impair considerably the antiscorbutic property. It seems well established that wine has less efficacy in preventing scurvy

than grapes; beer less than infusion of malt; rum less than molasses.

The acetous fermentation, on the contrary, seems in no degree to impair the antiscorbutic virtue. Pickles have equal efficacy with the fresh plants. Sour krout, made by subjecting sliced cabbages to the acetous fermentation, long had great celebrity as a preventive of scurvy.

It would seem, indeed, that the antiscorbutic principle may be even developed by the process of acetous fermentation. An article of diet, called by the Scotch *sooins* or *sowens*, made by subjecting oatmeal to the acetous fermentation, was considered by Sir J. Pringle and Sir G. Blane as a powerful preventive of scurvy; while it seems well established that oatmeal itself has no such virtue.

All these circumstances render it probable that the antiscorbutic virtue depends on the organic acids; or on some salt that enters the system only in combination with such acids. The latter supposition is the more probable, because the acids, pure, have much less efficacy in preventing scurvy than the vegetable juices from which they are derived. Lemon-juice evaporated to the consistence of syrup, as originally recommended by Dr. Lind, was found very inferior to the fresh fruit; and the crystallized acid, after being extensively tried, was renounced in favour of the juice preserved simply by the addition of a certain proportion of spirit. The notion that it is the mere acid that prevents and cures the disease, has, indeed, done much mischief, by leading men to infer that any other vegetable acid would do the same; and hence to trust to vinegar, to the great sacrifice of health and life among their seamen, long after experience had shown that it is a very inadequate substitute. Dr. Lind, in the middle of the last century, when scurvy proved so destructive in our fleets, remarked that few ships had ever been in want of vinegar. Testimony to the same effect has been given by other naval physicians. Sir G. Blane tells us that vinegar was liberally supplied to our fleet in the West Indies in 1780 and the two following years; but that, notwithstanding this, they had great losses from scurvy. Dr. Trotter, in his account of the health of the channel fleet, in 1795, says that vinegar was carefully served to the messes of the seamen, throughout the squadron; yet in those ships in which men took it in large quantities, it was not observed to retard the progress of the disease.

These facts render it probable that the antiscorbutic property does not depend on the mere acid of vegetables and fruits, but on some salt that enters the system only in combination with it.

In the history of scurvy we find frequent instances of the great craving that almost

always exists for substances much required by the system. Dr. Lind says that he has often observed, upon seeing scorbutic people landed at our hospitals, that the eating of oranges and lemons was attended with a pleasure more easily imagined than described; and the same remark has been made by other naval physicians. Bachstrom, in an account he has left us of the ravages of scurvy during the siege of Thorn, in Prussia, in 1703, says that when some of the coarsest vegetables were sent to the town by the besiegers, for the use of a particular family, they were seized on by the officers at the gates, and eagerly devoured as the greatest delicacies. A still more touching instance is given in the narrative of the famous voyage of Lord Anson, when, on their arrival at the island of Juan Fernandez, the grass even was considered a dainty, and eaten with avidity by the scorbutic sailors.

I cannot conclude these remarks on scurvy without calling attention to the need there is of some legislative enactment to render compulsory an adequate provision of lemon-juice to our merchant-seamen during long voyages. A measure of this kind could not be considered meddling or vexatious; for surely no one can claim the privilege of keeping men, for whom he has agreed to provide, on a diet which experience has fully shown to be inadequate to the maintenance of health.

I would also earnestly urge the importance of making a certain proportion of succulent vegetables an occasional article of food in jails, poor-houses, and especially in lunatic asylums; in fact, in all establishments where persons are kept a long while on a diet regulated by principles of economy, and subject to little variation.

In the provisioning of garrisons likely to be besieged, or of troops stationed in districts that have been laid waste, or where the winter is long and severe—in all cases where a difficulty of procuring fresh vegetables is likely to arise—I would recommend that lemon-juice, as in the navy, be provided instead. The history of the siege of Alexandria in 1801, of the French army of the Alps in 1795, of our own troops at the Cape of Good Hope in the autumn of 1836, and of some late campaigns in India, show that such advice is not altogether uncalled for.

LECTURE II.

IN my last lecture I considered the characters of Scurvy, and endeavoured to shew you, from a review of the circumstances under which it arises and of the means by which it is prevented and cured, that it results from deficient nutriment only; that its real cause is, prolonged abstinence from fresh succulent vegetables or fruits, or their pre-

served juices; and that cold, defective ventilation, and the various other causes assigned for it, have no influence in bringing it on, except in so far as they waste the body or impair nutrition.

Scurvy has not, I believe, been observed in any animal but man. Dogs and other carnivorous animals are kept in perfect health for an indefinite time on meat only; while man, though equally capable of digesting and assimilating animal food, becomes scorbutic at the end of a few months, if not allowed in addition some succulent vegetables or fruits, or some article prepared from them. It is not easy to account for this difference, for the animal tissues consumed by man must, it would seem, contain all the elements requisite for the nutrition of the corresponding tissues of his own body. Is it explicable from the fact that man is the only animal that eats his meat cooked? May not the antiscorbutic properties of meat, like those of vegetables, be impaired by heat?

Another form of disease from defective nutriment is brought on by a diet that contains no nitrogen, or an insufficient quantity of this principle. It is attended with wasting of muscles and other tissues; but its chief characteristic is a peculiar ulceration of the cornea.

For our knowledge of the true pathology of this disease we are indebted to some experiments performed by Magendie, and published, in 1817, in his work on Physiology.

In the first of these experiments, a small dog, fat, and in good health, was put on a diet of pure white sugar and water. Of each he was allowed as much as he would take.

For the first week he appeared to suffer no inconvenience; he was brisk, ate with avidity, and drank as usual. In the second week he began to grow thin, although his appetite continued good, and he ate as much as six or eight ounces of sugar in the twenty-four hours. The urine was abundant, but the evacuations from the bowels were neither frequent nor copious. In the third week the loss of flesh increased, the strength diminished, the appetite was less keen, and the dog lost his former gaiety. At this time a small ulcer appeared at the centre of the cornea, first in one eye, then in the other. The ulcer increased in size, and at the end of some days was more than a line in diameter. It increased in depth also, and soon the cornea was perforated, and the humours of the eye escaped. This affection of the cornea was attended by an abundant secretion from the glands of the eyelids.

The emaciation still went on; and although the dog ate from three to four ounces of sugar a day, he became so weak that he could neither chew nor swallow.

He died the thirty-second day of the experiment.

On examination after death, Magendie remarked that there was complete absence of fat; that the muscles were reduced to one-sixth of their ordinary size; that the stomach and intestines were also much diminished in size, and much contracted. The gall-bladder and urinary bladder were distended. The fluids they contained were analysed by M. Chevreul, who found that they had most of the characters which belong to the urine and bile of herbivorous animals. The urine was alkaline instead of acid, and offered no trace of lithic acid or phosphates. The bile contained a considerable portion of picromel, which also exists in large proportion in the bile of herbivora. The fæces, also examined by M. Chevreul, contained very little nitrogen, which usually enters very largely into their composition.

A second dog was submitted to the same regimen, and the same effects were observed; only that in this the eyes did not begin to ulcerate until the twenty-fifth day, and the dog died before perforation of the cornea had taken place. The muscles and abdominal viscera were in the same state as in the subject of the former experiment. The characters of the fæces, of the urine, and of the bile, were the same.

A third experiment of the same kind led to precisely the same results.

M. Magendie next put two dogs on an exclusive diet of olive oil and water. They seemed to do well on it for about a fortnight, when their health began to suffer in the same way as that of the dogs kept on sugar and water; with this exception, that they had no ulceration of the cornea. Both dogs died about the thirty-sixth day of the experiment, and presented the same phenomena, as regards the state of their organs and the composition of the urine and bile, as the subjects of the former experiment.

Dogs kept exclusively on gum and water became affected precisely in the same way.

Magendie, supposing these results to follow from deficiency of nitrogen, next tried the effect of feeding a dog on butter only; a substance which, like sugar, oil, and gum, contains little or no nitrogen. The results were the same as in dogs kept on sugar. The dog died the thirty-sixth day of the experiment, and at the time of his death had an ulcer on the right cornea.

Magendie concluded from his experiments, that the ill effects of any of those articles of food taken exclusively, results from the absence of nitrogen; that the nitrogen which enters as a constituent into all the materials of the body, with the exception of fat, is derived solely from the food; and that no animal can long subsist on a diet of which this principle is not an ingredient,

These conclusions were confirmed in the main by some experiments of the same kind performed by Tiedemann and Gmelin; and of late they have received additional confirmation from experiments made by a committee, of which Magendie was an active member, appointed by the Institute in Paris, to investigate the nutritive properties of gelatine. The following is one of their experiments:—

Four dogs were kept exclusively on the fat that surrounds a bullock's heart. At first they ate it with avidity, but at the end of a week they all declined it. They minutely dissected the pieces, laying hold of the smallest portions of muscular fibre, and of cellular tissue, that remained attached to the fat.

They all died: the first on the nineteenth day; the second on the twenty-fourth day; the third on the twenty-eighth day; the fourth on the thirty-fifth day. In all, ulcers appeared on the cornea. On examination after death, all the organs were found atrophied, *but infiltrated with fat.*

This experiment is interesting, as shewing that there may be great atrophy of muscle, and other tissues, in animals loaded with fat. The circumstance of the dogs rejecting the fat and picking out the smallest portions of muscular fibre, shews, what I have had occasion to remark when speaking of scurvy, the great craving felt for substances much required by the system.

It appears from the experiments I have related, that nearly the same effects are produced by keeping animals on an exclusive diet, consisting either of sugar, oil, gum, butter, or fat—substances which resemble each other in containing no nitrogen, or a very small proportion of it; they being all composed of carbon, or some hydro-carbon, and water. It was thence inferred that the ill effects of this diet resulted from deficiency of nitrogen, which entering largely into all animal tissues, must be necessary to repair their waste. This inference is, no doubt, to a certain extent, true, since Liebig and Dumas have satisfactorily proved that animals obtain their nitrogen solely from their food; but it is far too exclusive. It does not recognise the importance of other principles, which are wanting in these articles of food, but which, although less in amount, yet, like nitrogen, enter constantly into the composition of the body, and are therefore required for its support.

The body is made up of a great variety of elements—oxygen, hydrogen, carbon, nitrogen, sulphur, phosphorus, lime, iron, &c.—not convertible into each other, but each playing an essential part and never found wanting, and all, therefore, necessary for the nourishment of the various tissues. This truth was well illustrated by other experi-

ments of the Paris Committee. They found that animals kept exclusively on albumen, fibrine, or gelatine—substances which, being themselves materials of the body, contain a full proportion of nitrogen—died as soon as those kept exclusively on sugar or fat. But what is still more to the point, they also found that albumen, fibrine, and gelatine, together, are, when taken pure, insufficient for the nourishment of dogs: that while a dog is for a long time perfectly nourished by raw flesh, which, along with these elements, contains the requisite incidental principles, he wastes rapidly, and soon dies of inanition, if kept on a mixture of gelatine, albumen, and fibrine, in their pure state.

From this we must infer, that the ill effects of a diet consisting of sugar, starch, oil, fat, do not result from deficiency of nitrogen only, but from want of other principles also requisite for the support of the body. Perhaps the deficiency of each principle shows itself in a particular way, and becomes manifest in the defective nourishment of that part of the body into which it enters most largely, which is most rapid in its waste, or most delicate in its texture. We should thus have various disorders differing somewhat in their general aspect, but all the consequences of imperfect nutrition, and each having in some principle its specific remedy. Those disorders appear among the poor in towns, and in persons long shut up in prisons, asylums, ships, but from our ignorance of their physiognomy and distinctive characters, we rarely recognize their true origin and nature. Destruction of some tissue takes place, febrile action is excited, and a malady, which requires improved and more varied diet for its cure, is treated by abstinence and depletives.

All those disorders have this in common, that they occur only in persons who have been subjected for some time to a particular regimen; and that in prisons and asylums they show themselves first, and invariably prevail most, *in those who have been longest confined.*

It would appear, from the published accounts of the experiments of the Paris Committee, that sloughing of the cornea took place in those animals only whose food was deficient in nitrogen. It is probable, therefore, that Magendie was right in the opinion he very early formed, that it is to want of nitrogen that this particular effect is to be ascribed. We know that nitrogen enters largely into the composition of the cornea. Is it in larger proportion in the cornea than in the crystalline, which is equally delicate in structure, but which is not affected in the same degree by a diet deficient in nitrogen? The crystalline, however, is not exposed to the action of the atmosphere, which must increase the waste of the cornea.

It is not in the lower animals only, and in express experiments, that ulceration of the cornea takes place from defective nutriment. The same phenomenon is not unfrequently witnessed in natives of Indostan, who subsist chiefly on rice, which, in chemical composition, differs very little from sugar or starch; being composed of carbon and the elements of water, with little or no nitrogen.

Brett, in his "Surgical Diseases of India," says, "some deplorable instances of such disease occurred among the prisoners in the jails of Mooradabad, Shahjehanpore, and Cawnpore, under our personal observation; and, we believe, in various other parts of India. These unhappy creatures were subject, in the highest degree, to every debilitating cause—imperfect nourishment, their aliment possessing neither diversity nor multiplicity of ingredients; impure air, especially confinement at night in closed wards, surrounded by high walls; excessive heat in summer, sudden cold and great range of temperature in the winter months; fatigue and mental depression. Many of them were exposed to an endemic dysentery, under which, if they did not succumb, they became reduced to the very lowest ebb of debility, torpor, and apathy.

"Almost all the secretions were suspended, excepting that of the bowels. Their tongues were pallid, their extremities shrunk, and the surface of the whole body cold. Even in summer there was no cutaneous transpiration. Their eyes were glassy. Under this the inflammation of the conjunctiva occurred, an ulcer formed on the cornea, which speedily sloughed, and penetrated the whole of the layers, followed by an evacuation of the humours of the eye. It was particularly remarked in all the cases that there was no pain. There was increased secretion from the meibomean and lachrymal glands, and supuration of the conjunctiva; the anterior chamber became filled with a muddy, purulent, fluid; the ulcer of the cornea sloughed; the lens became evacuated, and the eyeball of course collapsed. Both eyes were often affected; and the patient generally expired in an extreme state of emaciation."

Mr. Brett adds, "the above phenomena resemble those exhibited in animals fed by Magendie on sugar, olive oil, and other unazotized substances, and those when the fifth nerve was divided within the cranium."

While visiting-physician to the Dreadnought, I observed a similar condition, though less in degree, in Lascars on their arrival in this country from India. Many of the merchant-ships trading between this country and India are manned almost entirely by these Indian sailors, who live chiefly on rice. Their health continues good for some months, but *towards the end of the voyage* it begins to suffer, and not unfre-

quently ulcers form on the cornea. My friend, Mr. Busk, has given me the following notes of four cases, admitted the same day (July 1840) from the same ship.

CASE I.—Mudor, æt 30, just arrived from Bombay, of which he is a native: was never in England before, but has been at sea eighteen years, in hot climates.

The whole of the right cornea is in a state of ash-coloured slough, overlapped at the edges by loose vascular folds of the conjunctiva, which is throughout of a deep-red colour; lachrymation; no purulent discharge.

The lower and outer two-thirds of the left cornea are in the same condition; the remaining portion is nebulous, and roughened on the surface by superficial ulceration. The pupil can be seen through this portion, and the iris appears healthy.

The right eye became affected before the left. At first there was severe pulsatile pain in the temples, and around the orbits; but, for the last three or four days, he has been quite free from pain. His health, in other respects, appears good, and he is not emaciated. Was quite well on leaving Bombay, and never had anything the matter with his eyes until two months ago, when this complaint came on.

He was discharged from the Dreadnought, on the 10th of August, nearly blind.

CASE II.—Ingan, æt. 34, native of Calcutta. Ten years at sea, and twice before in England. Had bad eyes three years ago in a ship called the Benares, but not since. There is now nebulosity and an irregular ulcerated surface towards the lower edge of each cornea. He has also painful swelling and stiffness of the left ankle, which he had injured a month before. The swelling, which is hard and considerable, is probably scorbutic. Has no other complaint.

CASE III.—Reunjonalli, æt. 50, native of Madras. Ten years at sea. Never had any complaint of the eyes until a month ago, when the left eye became affected. A fortnight afterwards the right became affected in the same way. Had had no pain in the head, but sharp, lancinating, pains, in the eyes themselves.

In the left eye the upper part of the cornea is tolerably clear, but the lower two-thirds are opaque, of a dirty-olive brown, and of irregular surface: vision is nearly destroyed in this eye.

The right eye still retains considerable vascularity. About two-thirds of the cornea have apparently sloughed, at least through the external laminae, and the iris has fallen forwards and bulged outwardly. Has still lancinating pains in this eye.

He was discharged convalescent on the 8th of August.

CASE IV.—Muhamet, æt. 21, native of Cochin. Four years at sea. First voyage

to England. Had nyctalopia a month ago, but no ophthalmia till the last fortnight. Has now inflammation of the conjunctiva, and a small but deep ulcer on the inner edge of the cornea of the left eye.

He was discharged convalescent on the 11th of July.

All these men came, as I have remarked, from the same ship, and during the voyage had fared alike. Their food consisted of rice, salt-fish, ghee (a sort of butter), curry of fish, and sometimes peas. In their own country, in addition to these articles of food, they have fresh vegetables, milk, bread, and occasionally meat.

The treatment adopted was the same, or nearly the same, in all, and consisted of milk diet, with fish and eggs; bark and soda; blisters; and solution of nitrate of silver to the eyes.

The frequent occurrence of this ulceration of the cornea in Lascars, whose diet while at sea has little variety; the fact that it shows itself only towards the end of a long voyage, and that fresh sailors are not affected after their arrival in port, when their diet is again more varied; and the circumstance that both eyes are generally affected alike, show that it has its origin in imperfect nourishment.

It's not being always attended with great emaciation, further shows that it does not result from simple inanition, but from want of some elementary principle in the diet. What this principle is, we cannot as yet pronounce with certainty. The circumstance noticed in the account of Mudor, that he was not emaciated, tends to show that in this case nitrogen is not the principle in default. Nitrogen enters largely into the composition of the muscles, which are always found much wasted in animals kept on a diet deficient in this principle. The muscles, however, might have been wasted even in this case, and the appearance of emaciation prevented by the presence of fat, which the eating largely of rice would tend to produce.

The disease in the Lascars is not perhaps precisely the same in origin as the disease observed by Mr. Brett in the jails in India. He expressly remarks that the sloughing of the cornea and destruction of the eye is unattended with pain; while all the patients brought into the Dreadnought complained of severe pain in the eyes and temples. The prisoners had also diarrhoea, and various other ailments wanting in the sailors. Their diet was probably more restricted than that of the sailors, and the disorder of health greater.

The ulceration of the cornea in Lascars is quite independent of scurvy. The two diseases may occur together, each arising from

its own special cause, but they have no necessary connection with each other. Three of the four Lascars whose cases I have given had no marks of scurvy; while of the numbers of men I have seen brought into the hospital from English vessels, in the worst state of scurvy, there has not been one with the slightest ulceration, or even opacity, of the cornea.

Neither scurvy, nor the disorder of the Lascars, is attended with much impairment of intellect or memory, or with any striking nervous symptoms, to show that the nutrition of the brain or nervous centres is much affected. The brain contains a large quantity of fatty matter, and its nutrition suffers when there is imperfect assimilation of carbonaceous matters. The wasting of the brain in diabetes, and the weakness of intellect that attends it, are no doubt owing to imperfect nutrition of the organ.

Without a knowledge of the particular element wanting in the food of Lascars, we cannot point out a more definite means of prevention than a more varied diet. If nitrogen were the deficient element, it might be supplied by cheese, into which this principle enters largely, and to which they have no religious objection. I should strongly recommend a large stock of this article in ships manned by Lascars.

But these are not the only circumstances in which ulceration of the cornea results from imperfect nutrition. The same thing occasionally happens in the advanced stage of typhoid fever, when the body has been much reduced, and the patient long kept on a uniform low diet, or on a diet composed of farinaceous matters chiefly.

The first instance of this that attracted my attention was in a lad under the care of Dr. Watson, in the Middlesex Hospital, in 1836. He had been ill some time of fever, when superficial ulceration appeared on the lower half of each cornea. Dr. Watson requested Mr. Arnott to see the patient with him, and the result of their consultation was, to order animal food, quinine, and a lotion, containing nitrate of silver, to the eyes. These measures immediately arrested the ulcerative process, and the lad rapidly recovered.

In the three following years, during which I had to treat a large number of fever cases in the Dreadnought, I met with four instances of the same kind, all occurring in an advanced stage of fever, before a generous diet had been granted.

The ulceration, as in Dr. Watson's case and in the Lascars, occupied the lower half of each cornea. It was superficial, and appeared alarming from the rapidity with which it spread; but its progress was immediately arrested, and the ulceration rapidly healed, without leaving a visible cicatrice,

under the influence of animal food, wine, quinine, and the local application of the 4 gr. solution of nitrate of silver. The ulceration was proof, in each case, that an error of treatment had been committed in keeping the patient too long on a uniform or un-nutritious diet.

The ulceration was attended with pain, and with redness of the conjunctiva. The circumstance of its affecting chiefly the lower half of the cornea is perhaps attributable to this half being more exposed than the upper half, which is somewhat screened by the dropping of the upper eyelid, especially in the state of prostration that attends continued fever.

After protracted fevers, the intellect often remains for a long time childish; and the hair falls off, or becomes fine and curly; the effect probably, like the ulceration of the cornea, of defective nutrition.

The great wasting of the body in typhoid fever renders the effects of insufficient diet more obvious; and is the cause of the ravenous appetite, and the great craving for animal food, that exists during convalescence, and until the body is restored to its healthy standard. It is another instance of the great relish there almost invariably is for substances much required by the system. It is unnecessary to add, that this longing for animal food should, with certain precautions, be always indulged.

Ulceration of the cornea from defective nutrition, probably occurs occasionally in most diseases attended with great wasting, especially during the period of growth, when the wants of the system are greatest, and when the effects of an insufficient diet are most quickly seen. In confirmation of this, I may cite the following passage from Dr. Mackenzie's work on Diseases of the Eye:

"The subjects of ulcer of the cornea, and especially of the deep ulcer, are rarely robust or in a good state of general health. On the contrary, they frequently present the indubitable signs of great weakness, and sometimes even of inanition. In emaciated infants particularly, I have repeatedly seen the cornea of one or both eyes become thin and prominent, and give way, without much, and even without any apparent inflammation. The wasted state of the body, in such subjects, arose from various causes, as chronic diarrhoea, cough following measles, and syphilis. In 1832 I saw several instances of the same destructive ulceration of the cornea, occurring after malignant cholera. I have sometimes been led to compare the state of such eyes to those of the dogs in Magendie's experiment, which being fed, or rather starved, on white sugar and distilled water, died from exhaustion; their death being preceded by perforating ulcer of the cornea, and evacuation of the humours."

Ulceration of the cornea, like scurvy and

other diseases from imperfect nutrition, shows itself most in those who have been wasted by previous illness. There can be little doubt that simple losses of blood would have the same effect as exhausting maladies, and cause ulceration of the cornea in persons kept on an insufficient diet, or who, from some weakness of the assimilating organs, are imperfectly nourished.

Magendie has shown that this effect is produced by merely abstracting the fibrine of the blood. He bled an animal frequently, and after each bleeding again injected into its veins the blood deprived of its fibrine. After this operation had been several times repeated, at certain intervals, the conjunctiva became red, the cornea opaque, the impression of light painful; the animal had, in short, all the symptoms of severe ophthalmia. At the same time he became dejected, and the skin ulcerated in all those parts on which the weight of the body rested. The eyes were rapidly cured, and the animal restored to its former condition, without any other remedy than a nourishing diet.

Does the hair, which becomes weak and fine after fevers, undergo a similar change after exhausting losses of blood?

The chronic ulceration of the cornea in scrofulous subjects, has many characters in common with the ulceration I have already noticed, and which shew that it depends on imperfect nutrition. It comes on during the period of growth, and in children reduced by measles, scarlatina, hooping-cough, or any exhausting malady. The fact of scrofula coming on after each of the eruptive fevers, shows that it does not depend on the *special* nature of the poison, but on the exhausting influence of those maladies which reduce the body and weaken the assimilating functions.

It differs from the former cases in not being caused solely by deficiency of food, but by weakness of the assimilating organs. Imperfect nutrition may obviously result from either of these causes—from insufficient food, or from weakness of the assimilating functions, which are unable to convert the food into the constituents of the body. Of disease produced in the latter way, perhaps the best example is diabetes: the food may be more than sufficient for health, but the powers of digestion are weak, and the saccharine principles, instead of being assimilated, pass through the system without contributing to its support.

Scrofulous ulceration of the cornea, and scrofulous disease in general, is chiefly dependent on imperfect assimilation, and may often be traced to inherited weakness of constitution; but its frequent occurrence after exhausting maladies, its great prevalence among children who are ill fed, and the good effects of a richer and more varied diet, shew

that insufficient food is of itself sufficient to produce it.

Among the remedies of scrofula, pure air, and a tonic, nourishing, regimen, will, perhaps, always occupy the first place.

The cornea—from being an object of sight; from its extreme delicacy, which makes it so susceptible of changes of structure; and from its transparency and office, which at once betray every change of structure to the patient and to others—is admirably adapted to give indication of defective nutrition, as for as the elements which enter into its own composition are concerned. But we must not suppose that the effects of deficient nourishment are manifested solely, or always first, in this structure. We have seen, indeed, that, in the most advanced stages of simple scurvy, the cornea never suffers.

The strange forms of disease that swell the mortality during seasons of famine, and the changes of structure that we find in various organs in persons dead of chronic diseases, in which the assimilating functions were much impaired, show that there are many other forms of disease produced by defective nourishment, and that much is yet wanting to complete this important chapter of general pathology. We have just an intimation that softening and ulceration of the intestines, and softening of the brain, are in some cases the consequence of insufficient nutriment, and are best treated by tonic remedies and a nourishing regimen.

A consideration of the forms of ulceration of the cornea which I have brought together, shows, what an attentive study of the diseases of any organ will force upon us—that the treatment, at any rate the general treatment, should be directed less by the external characters of the diseases, which are often alike in diseases essentially different, than by the nature of the cause by which the disease was produced. It is the cause of an inflammatory affection that mainly determines its course and character, and the influence that remedies exercise over it. Every department of pathology abounds with illustrations of this principle; and shews us the paramount importance of a searching inquiry into the causes of disease.

Since excess in one element affords no compensation for deficiency of another, and since there is almost universally a great craving for substances required for the system, animals kept on articles of food that contain a small proportion of nitrogen will consume a proportionably large quantity of them. Potatoes contain but little nitrogen, and therefore must be eaten in large quantity if they are to form the sole support of the people. An Irishman eats many pounds of potatoes a day, and even then is very imperfectly nourished, if he has no butter-milk, or other food that

contains a larger share of nitrogen. This fact was known more than a century and a half ago. Sir C. Wren, at one of the meetings of the Royal Society, at which he presided, remarked, “that it had been of late discovered that the blacks who live only upon potatoes are apt to die of dropsy, and that therefore the planters had found it necessary to allow them bread and milk, which prevented it; and that in Ireland, where the people feed much on potatoes, they assist themselves by drinking sour milk, to make the potatoes digest the better.”

Rice, like potatoes, contains a very small proportion of nitrogen, and in India, where it forms the chief subsistence of the people, the quantity which each man consumes is almost incredible. In India, and in Ireland, the consumption of starch is much greater than the system requires; and, as Liebig has remarked, the superfluous quantity either passes through the bowels undigested, or is expended in the formation of fat.

It is therefore a principle, not of humanity only, but of economy, in all prisons and workhouses, to supply the inmates with the elements required for health in their due proportion. Whatever of any one principle is in excess, passes through the system without contributing to its support, and without allaying the sense of hunger which the absence of other principles may occasion. To a man kept on potatoes, an ounce of meat or cheese will give more support, and more allay the sense of hunger, than a pound of rice.

Another instance in which the effects of insufficient nutriment are most painfully felt is in prisoners kept long on a diet of bread and water. The best proof of the ill effects of such a diet is perhaps to be found in some experiments performed in 1769, by Dr. Stark, on himself; because here they were not aggravated by confinement and the other depressing circumstances that deteriorate the health of prisoners.

These experiments were commenced on the 12th of June; and from this time to the 24th, the Dr. allowed himself 20 ounces of bread and 4 lbs. of water a day: he lost daily 5 oz. 5 dr. in weight. From the 24th of June to the 19th of July, he took 30 oz. of bread and 2 lbs. of water; and lost in weight 6 oz. 10 dr. a day. The next week he allowed himself 38 oz. of bread and 3½ lbs. of water; and during this week increased in weight. He then varied the experiment, by subtracting a certain quantity from the daily allowance of bread, and adding an equal weight of sugar. From the 26th of July to the 3d of August, he took 34 oz. of bread and 4 oz. of sugar; and from the 3d to the 9th of August, 30 oz. of bread and 8 oz. of sugar; the allowance of water being in each case 3½ lbs. a day.

The person upon whom these experiments were performed was, to use his own words, "a healthy man, about 29 years of age, six feet high, stoutly made, but not corpulent, of a florid complexion, with red hair."

Once during the course of these experiments he yielded to his craving for food of other kind, and ate 4 oz. of meat, and drank 2 or 3 glasses of wine; but otherwise he adhered rigidly to the diet. On the 9th of August he was only two pounds less in weight than when he commenced his experiments; but scurvy was making its appearance.

The following are some of the entries made in his journal about this time:—

"On the 11th, I ate 24 oz. of bread and 16 oz. of sugar, but the last part of it with great abhorrence. I now perceived small ulcers on the inside of my cheeks, particularly near a bad tooth in the lower jaw of the right side; the gums of the upper jaw of the same side were swelled and red, and bled when pressed with the finger; the right nostril was also internally red or purple, and very painful; I had one thin stool.

"On the 12th, I ate 30 oz. of bread, with 10 of sugar; had little appetite for supper, and after it a thin stool.

"On the 13th, having been extremely ill during the night with pains in my bowels and sweating, at day-break I had a large thin stool, and two liquid stools afterwards, but passed no wind, nor was troubled with any in my bowels. I had no appetite for breakfast, could not taste sugar, dined on a few ounces of meat with about 12 oz. of bread, and drank 2 or 3 glasses of wine.

"On the 14th, I perceived some small purple streaks on my right shoulder.

"On the 15th, the affection of my gums, though less in degree, had become more general, having spread to the left side; their semilunar edges were of a deep red; and several drops of blood issued from my right nostril.

"N.B.—Until the 18th, I had every day three or four liquid stools, containing some clear gelatinous substance, and felt but little pain or wind in my bowels."

After having lived irregularly for a week, he tried the effect of taking olive oil, instead of sugar, with his bread; and from the 24th to the 30th of August, his diet was 30 oz. of bread, $\frac{1}{2}$ oz. of olive oil, and 3 lbs. of water, a day. From the 30th of August to the 5th of September, the same quantity of bread and water, without the oil. He then again lived irregularly.

As might have been expected, the scorbutic symptoms and the debility constantly increased. On the 23d of August, he had a tooth, which had been for some time troublesome, extracted. "The day following," he writes in his journal, "I had great pain in the part from whence the tooth was taken,

and the gums appeared somewhat black. The second night I had no sleep from the excessive pain; and an abominably putrid slough was formed. The gums in the neighbourhood of the sore swelled more than ever, and became in part livid, with a fetid white stuff round their edges; while the gums immediately over the sore were black and insensible."

"On the 8th of September, I was so weak and low, that I almost fainted in walking across my room; had four or five loose stools in the course of the day; was sick; and my tongue foul."

It would be useless to pursue this painful narrative, which goes on detailing other experiments of the same kind, continued until the month of February, when the Doctor, reduced to the most deplorable condition, fell a victim to his own experiments.

The case of Dr. Stark confirms what I have before stated—that scurvy may exist in a high degree without perceptible loss of flesh. It shews, also, that under the most favourable circumstances, and when the restriction is voluntary, a diet of bread and water is insufficient for the support of health. Another point established by the Doctor's experiments, is, what with our present knowledge we might have anticipated, that the sugar added in one of his experiments was no equivalent for the same weight of bread subtracted. With 38 oz. of bread, he gained 3 oz. 6 dr. a day in weight; with 34 oz. of bread and 4 oz. of sugar, he gained 2 oz. a day; with 30 oz. of bread and 8 oz. sugar, his weight was stationary. The sugar, composed entirely of carbon and water, was less nutritious than bread, which, besides starch, which is equivalent to sugar, contains gluten, a substance rich in nitrogen.

We could scarcely expect that the effects of a bread and water diet would be less severe in prisoners, who are subject to confinement and other depressing influences. A painful sketch of them has been given by Mr. Malcolmson, in a letter he addressed, in 1837, to Sir H. Hardinge, on the effects of solitary confinement and bread and water diet on the health of prisoners in India. He says, "Many men, particularly those of indolent habits, endure a confinement of four or six weeks on bread and water without injury to their health; but in some instances a shorter period is sufficient to cause a total loss of appetite—the bread is hardly touched, and on other food being allowed, the patient is unable to eat or to digest it. The stomach becomes weak; there is uneasiness across the stomach, spleen, and liver; the latter is torpid; the bowels are confined, or they are relaxed with slimy discharges unaccompanied with pain; yet the swollen red tongue indicates the existence of irritation of the mucous membrane of the digestive canal.

The pulse is quick and feeble; and the clammy skin, vertigo, debility, headache, and sleeplessness, shew how much the constitution suffers from diminished nervous power. The convalescence is slow, and the treatment requires to be adapted to the enfeebled state of the system. The effect is, however, more clearly seen in men sentenced to six or twelve months' solitary confinement. Two of these were in hospital at the same time, with decided symptoms of scurvy. One was admitted after five months' confinement, during part of which he had been allowed extra diet at my recommendation. It was observed that, for some time previous to his removal to the hospital, his daily allowance of bread was removed almost untouched. He complained of pains of the limbs, along the spine, and across the loins; tenderness of the shin bones; hardness, pain, and feeling of stiffness, of the calves of the legs; and the skin over the painful muscles was of a dark livid colour, from effused blood. The gums were spongy, livid, and retracted; and he suffered from sleeplessness, some pain of the region of the liver, and slight griping. The tongue was yellow, and its edges red. The other had been a shorter time in confinement, and complained of debility, disorder of the bowels, pains of the shin bones, &c. &c. A blister was applied, which caused a foul sore, from which dark-coloured blood flowed on the slightest touch."

Mr. Malcolmson found, by inquiries made two years subsequently, that one of those men had hardly been out of hospital during that time, and had not then completed his full period of confinement; and that the other was very frequently on the sick list, with a variety of complaints: that, in fact, the health of both was irretrievably ruined. There can be no doubt that these effects are chiefly to be ascribed to the diet; for Mr. Malcolmson observes, in a subsequent part of his letter, that he has not met with an exactly similar train of symptoms, induced by solitary confinement, in healthy soldiers, when their ordinary rations were allowed them.

It appears from these instances given by Mr. Malcolmson, and from the touching case of Dr. Stark, as well as from the experiments of Magendie, that when an animal has been kept long on a diet deficient in nitrogen and other necessary principles, his health is irretrievably ruined. The allowing him a sufficient diet afterwards does not restore him. In this respect these forms of disease differ from simple scurvy, as it occurs in sailors, from the highest degrees of which men rapidly recover under the use of antiscorbutics, and which, as far as we can judge, does no permanent harm to the constitution.

The urgent remonstrances of Mr. Malcolmson, with respect to the effects of solitary confinement and a diet of bread and water, were attended to; and he had soon the satisfaction of seeing the success of his efforts for the abolition of this mode of punishment in the Indian army.

But instances of the kind mentioned by Mr. Malcolmson are not, or at least were not a few years ago, confined to the prisons of India. In the reports of the Inspectors of Prisons for 1836, you will find many instances of the insufficiency of a bread and water diet to support life for any considerable time.

In the House of Correction at Little Walsingham, Norfolk, the diet of the prisoners consisted of bread and water only. The allowance of bread was 2 lbs. 6 oz. for those at hard labour; 2 lbs. for those not at hard labour. Prisoners sentenced for more than three months were allowed half a pound of meat once a week.

The surgeon in his report states, that there are very few prisoners who can be maintained in health longer than three months; and that he is obliged to make frequent changes of diet, by ordering porter and antiscorbutics, to repress scurvy, which occasionally makes its appearance, and, if not checked, would prevail to a considerable extent.

The cost of extra allowances made during the year, by order of the surgeon, was more than a thirteenth part of the cost of the prison diet for the year: a considerable proportion, when it is considered that extra allowances would scarcely be granted to those whose term of imprisonment was short.

From the preceding accounts, one might have anticipated the effects of the cruel system of starvation practised in the gaol at Swaffham. Here also the diet was bread and water. The prisoners, when committed for seven days, were allowed 1 lb. of bread a day; when for more than seven days, and less than three months, 1½ lb. a day; when for more than three months, and less than six, 2 lbs.; and when for six months, 2½ lbs. of bread a day, and ¼ lb. of butter a week. But on their recommittal for less than six months, only 1½ lb.; for six months, 2 lbs.; and for more than six months, 2½ lbs. of bread a day.

The surgeon states that low fevers, debility, and scorbutic complaints, prevail to a very considerable extent among the prisoners; that they frequently lose their teeth from the effects of scurvy, and, being unacquainted with its symptoms, they do not usually complain until the disease has made considerable progress. It is indeed quite evident that few prisoners could live three months on this system of diet if fully carried out. A sentence of three months' impri-

sonment, passed perhaps for some slight-misdemeanour, would be sentence of the most lingering and cruel death. But the system was not, and indeed could not be, fully carried out. The symptoms of starvation became manifest, and the surgeon was obliged to break in upon the prison allowance, by frequently ordering porter and other nourishing food. It appears from the accounts, that the cost of extra articles ordered by the surgeon was nearly one-seventh of the cost of the entire maintenance of the prisoners.

It may indeed well excite surprise that such a system should have been attempted, nearly a century after the experiments of Dr. Stark had shewn conclusively that such a diet, continued under the most favourable circumstances, for a much shorter time than three months, is utterly ruinous of health. It is another striking instance of the general ignorance that prevailed until lately on this most important subject. This ignorance is amusingly shewn, if indeed a thing so fraught with suffering can be matter of amusement, in the following order made by the visiting magistrates of the Swaffham prison, in November 1835:—

“ Ordered by the visiting magistrates :— That, in consequence of the representation of the surgeon, all prisoners, convicted for a longer period than one month, to have an addition to their present diet of *one pint of gruel* each, with salt and onions therein. Also, that all prisoners, convicted for any period exceeding three months, be allowed (three days in a week) one pound of potatoes instead of half-a-pound of bread; such allowance to commence at the expiration of the period of three months.”

One cannot restrain a smile at the cautious way in which these worthy justices make the concession of allowing the prisoner, after he has been kept three months on a pound and a half of bread, and a pint of gruel, a day, to exchange, three days in a week, half a pound of bread for a pound of potatoes. He would find it a poor exchange; for bread contains much more than twice the quantity of carbon and nitrogen—and, in short, of all the elements of nutrition, except water—than an equal weight of bread. What a notion they must have had of their own gormandizing! One can scarcely help wishing that they should be compelled to purchase exemption from their next fit of gout by a month's restriction to the prison regimen.

It is stated by Müller that, in Denmark, a diet of bread and water for four weeks is considered equivalent to the punishment of death. The effects of such a diet must vary considerably with the quality of the wheat, which contains a much larger proportion of gluten, and is proportionally more nutri-

tious, when grown in warm than in cold countries. The proportion of gluten in wheat grown in Italy is stated to be from 18 to 24 per cent.; while in fine Scotch flour, lately analysed by a committee at Glasgow, the quantity of gluten amounted to 6 per cent. only of the original flour. It has been ascertained by the Paris committee, whose labours I have already alluded to, that it is to its containing a larger share of gluten—a substance rich in nitrogen—that wheat owes its superiority over other corn as an article of food: that while the starch separated from flour gave little nourishment to dogs, the glutinous matter that remained was of itself sufficient to maintain them in health for a considerable time.

I am afraid you will deem me tedious in entering into all these details; but I do so from a conviction of their importance, and from a persuasion that, in the different positions you may occupy, in the navy and army, in our colonies, and as medical officers of workhouses, prisons, and asylums of our own country, you may alleviate or prevent much human suffering by the knowledge of what is really essential for man's support, and the various disorders that result from defective nourishment.

I am far from wishing to encourage any morbid sympathy with criminals, or from desiring that the food and comforts of men who have violated the laws of their country should exceed those of honest labour. But it is surely right that the effects of their diet should be clearly established,—that the nation may form an estimate of the degree and nature of the punishment which its laws award to crime.

Another point that I wish to impress on you with respect to the diet of prisoners is, that the quantity of food necessary for the maintenance of health varies with the degree of labour. Prisoners condemned to hard labour require much more food than those of whom no labour is exacted. No fact in physiology is more certain than that muscular exertion causes waste of the body: it increases the elimination of carbon by the lungs, and, it is said, of nitrogen in the urine. But the fact did not require the sagacity of physiologists and chemists to discover. It has been established by the experience of all ages, and is become a fixed article of popular belief. In the regimen of prisoners it is almost invariably attended to; but in looking through the Reports of the Inspectors of Prisons, I find a few instances in which it has been shamefully disregarded. In the Worcester county jail, for instance, until lately, prisoners on summary convictions for one month, and vagrants for the first month, received only one pound of bread and one quart of gruel daily, notwithstanding their being at hard labour.

You will also bear in mind that a greater quantity of food is required after the system has been reduced by sickness. The convalescents from sickness should therefore be allowed more than the ordinary prison allowance, when, as is usually the case, this is on the lowest scale by which a system of health can be maintained. It is of no use to attempt to violate this law. Any infringement of it, as of other natural laws, must be followed by a penalty; which here, however, will fall unjustly, in the form of returning sickness, on the prisoner.

I have already remarked, that the disorders produced by insufficient nourishment are most manifest, when the body has been reduced by losses of blood or wasting illness, and during the period of growth.

During growth, when not the daily losses only have to be repaired, but the framework of the body has to be built up, the demands of the system are great, and the appetite is proportionally keen. Children eat because they are hungry, and rarely suffer from excessive nutrition.

During manhood, when the body has attained its full growth, the daily expenditure only has to be made up, the appetite is less keen, and its returns less frequent: it is then provoked by stimulating and high-seasoned dishes; more food is habitually taken than the system requires, and, after a time, gout, bilious disorders, and other effects of over-feeding, make their appearance.

In old age, from the weakness of the assimilating functions, these become again less frequent. Gout rarely appears before twenty; and seldom for the first time after sixty. From twenty-five to fifty is the period of life most exposed to those disorders. Women are in great degree exempt from them, chiefly perhaps from the periodical discharges to which they are subject during this stage of their existence.

A disease of imperfect nutrition, frequently seen in children, is rickets, which is characterized chiefly by pliability of the bones, which yield to the weight of the body, and become crooked and much distorted. This softness and pliancy of the bones is owing to their containing an insufficient quantity of phosphate of lime.

This condition of the bones, like scrofula and other diseases of imperfect nutrition, may result from weakness of constitution, and consequent imperfect assimilation of the food. But it may assuredly arise also from deficiency of food, or rather from a diet deficient in lime and other elements of which the bones are made up.

If a child be kept too exclusively on what Dr. Prout calls the saccharine principles—substances composed of carbon and water; or on these and oleaginous principles, as

butter and fat, he may be loaded with fat, but his muscles and bones will be imperfectly developed. The muscles will be small, the child unable to stand, and the bones rickety and bent from the weight of the body. A diet composed of carbon and water cannot supply nitrogen, phosphorus, lime.

The proper remedy in such cases is change of diet. The child should take less sugar and butter, and have animal food instead. A wine-glassful of lime-water, two or three times a day in milk, is said to be of considerable efficacy. Indeed, here, as in scurvy, and the other instances already mentioned, there seems to be an instinctive craving for substances required by the system. Liebig states that children whose food does not contain lime enough to form their bones, eat the lime of the walls with as much relish as their meals. It is the same unerring instinct that leads hens, while laying, to eat with greediness, and even fight for, an empty egg-shell. The lime it contains is needed for a new egg. It was a short time ago stated in a letter in "The Times," that hens will lay many more eggs if freely supplied with pounded egg-shells,—a truth long acted upon by thrifty market-women. When their food does not contain a sufficient quantity of lime, hens either cease to lay, or lay soft eggs.

The circumstances unfavourable to the development of bones in children, also retard, of course, the union of fractures. Fractures are slow in uniting in rickety children. An insufficient diet may long retard, or prevent altogether, the union of fractures in a grown-up person. Of this the following instances are given by Sir B. Brodie:—

"A gentleman was growing fat, and not liking to do so, he put himself upon a very spare diet, though accustomed to good living previously. After six months of starvation, he broke his arm, and the bones would not unite. I saw him many months afterwards, and there was scarcely any union even by soft substance. Another patient about whom I was consulted, a lady, was growing fat, though she would also prevent it by pursuing a similar system of diet. Some months afterwards she broke her arm, and union did not take place."

A more striking instance of the effect of insufficient nourishment in preventing the union of fractures, occurred during Napoleon's expedition to Egypt. It is stated by Baron Larrey, who was chief surgeon of the army, and whose account of the prevalence of scurvy in Alexandria during the summer of 1801 I have already cited, that almost all the fractures of the extremities, especially of the humerus from gun-shot wounds, received by the French soldiers in Syria,

were followed by false joints. He ascribes this to the continual movement of the wounded soldiers; to the influence of the malarious atmosphere of Syria; and to the insufficiency and bad quality of their food. All these causes, he says, may have prevented the formation of callus, by displacing the bones, or by diminishing the quantity of phosphate of lime.

During pregnancy the condition of the system so far resembles that of childhood that more nourishment is required than would suffice to supply the daily waste. A new body has to receive its increase from the materials eaten by the parent. The formative process in the fœtus is more active; its demands for the materials of growth are more urgent, and are first supplied. As might have been expected, numerous cases are on record in which bones fractured during pregnancy have shown no tendency to unite before the birth of the child. It is probable that in every case the union of fractures is more slow, and that scurvy, ulceration of the cornea, and other effects of insufficient nutriment, show themselves earlier during pregnancy and lactation than at other times.

Many cases are also recorded showing the slowness with which reparation of fractures takes place in persons much wasted by fever, or other illness. All those instances are illustrations of what may be laid down as a law,—that the effects of insufficient nourishment will be earliest seen when the demands of the system are greatest—when a new body has to be built up, or the losses of a grown one repaired.

The teeth resemble bones in chemical composition, containing a large proportion of phosphate and carbonate of lime. The enamel differs from the osseous substance chiefly in containing no animal matter, or a very small quantity of it, and a larger proportion of the salts of lime. We might expect, therefore, that the causes which retard the growth of bone would, if they act during that period of life when the permanent teeth are formed, retard the development of the teeth. Such is found to be the case. Persons of scrofulous constitution, more especially women who during childhood were delicate, or were much reduced by eruptive fevers or other wasting illness, have often small teeth with an irregular pitted surface, from the partial absence of enamel, which was formed in too small quantity completely to cover the teeth. Teeth of this kind early decay, from the corroding action of the food and secretions of the mouth which lodge in the depressions caused by the absence of enamel.

We not unfrequently see two or four corresponding teeth, which were formed at the same time, deficient in enamel, and carious,

while others are not. If one tooth decays, it generally happens that its fellow soon after suffers similar decay, commencing at the corresponding point, and following the same march. Accidental circumstances may hasten the decay, and explain the circumstance that one goes before the other, but they do not cause it: the real cause of the decay is defective enamel at the part. In many cases this may no doubt be traced to some exhausting illness at that period of life when the teeth in question were forming.

This condition of the teeth, like scrofula and rickets, is no doubt most frequently caused by imperfect assimilation, and is the consequence, not of deficiency of food, but of weakness of the assimilating functions. But, like those other diseases, it may unquestionably be brought on by deficiency of food, or rather by a diet deficient in the elements which enter into the composition of teeth.

Teeth differ from bones in this, that a great part of their mass is destitute of vessels, and undergoes no nutritive interchange. This is an advantage so far as when once formed they are in a great measure independent of the health. Bones may become soft in after life; but teeth remain the same in composition as they were formed in childhood. But this advantage is purchased by the evil, that they retain through life the defects of their first development. The soft bones of ricketty children become firm by the subsequent deposit of lime; but teeth at first deficient in enamel always remain so.

On seeing the negroes brought into the *Dreadnought*, I have often been struck with admiration of their large beautiful teeth, which rarely present the slightest trace of decay. In this, and in their heavy, massy skulls, they strongly remind us of the carnivorous animals. The question at once occurs, are these peculiarities at all owing to their diet or mode of life in childhood?

We might suppose that the great excellence of their teeth was a peculiarity of race, and independent of any particular habits of life; but this supposition is, I think, rendered improbable, by the circumstance that the teeth of the aborigines of New Holland, a very different race, are equally perfect. In 1839, my friend Dr. Stanger gave me one of five skulls, which he abstracted himself, with much difficulty and danger, from a burying-ground of the original inhabitants of New Holland. Two of these skulls were evidently the skulls of persons advanced in life. One of the skulls, that of a woman, had one decayed tooth. In two others, one upper front tooth was wanting (most probably knocked out by a blow), and the corresponding alveoli were obliterated. With these exceptions, the teeth in all the skulls were in the most perfect state.

Hair and nails frequently suffer from defective nutrition. The hair falls off after fever; the nails become dry and crisp in diabetes, and curved in phthisis. The effects of imperfect nutrition in nails are not permanent, unless there is defect in the matrix, because the nails are continually renewed. As indicating the state of nutrition at the time, the nails are perhaps not sufficiently regarded, especially in children.

Gentlemen,—I have now given you a very imperfect sketch of the known disorders produced by defective nutriment. You have seen, that since the body of man is made up of various elements,—of carbon, nitrogen, sulphur, lime, phosphorus, &c. which cannot be formed one of another, and which are each essential to the formation of some organ or tissue, that his diet must be varied in kind: that if we attempt to keep him on a diet deficient in these necessary elements, various disorders arise, differing in their aspect, and in the structure affected, according to the particular element wanting. Numerous facts, both in nurture of animals and in agriculture, point out the importance of various incidental principles, small in absolute amount, but apparently not the less essential to the due development of the structures into which they enter as constituents. With all these principles we are perhaps not yet acquainted. You will see, therefore, the prudence of recommending a varied diet; and you might expect, what indeed really happens, that if men, and more especially children, be kept long on the uniform and regulated diet of our prisons, workhouses, and asylums, some disorder, the result of defective nutriment, is almost sure to arise. These disorders are, as I have said, various in their aspect; and with the characters of many of them we are, no doubt, imperfectly acquainted. I cannot therefore delineate them all; but they have this character in common, which in doubtful cases may assist your judgment—that they occur chiefly, and prevail most, in persons longest confined, and in those reduced by losses of blood or exhausting illness. Whenever, in a jail or asylum, or during a voyage or a siege, you see a strange disorder having this character, suspect that it has its origin in imperfect nourishment. The character is the more valuable, as the contrary generally happens with malarious diseases and fevers—which attack strangers more than those long resident in the unhealthy locality.

Another circumstance that cannot fail to have arrested your attention, is the instinctive craving for substances required by the system. The longing desire which a scorbutic sailor has for greens and vegetables, which a man convalescent from fever or a child kept too exclusively on sugar and starch, has for meat, is the result of laws

framed by a higher wisdom than ours. We should take care, short-sighted as we are, that we are not too officious in the management of children, and in the treatment of disease; and that we do not, without good reason, oppose the gratification of these instinctive cravings.

LECTURE III.

ANOTHER disorder that frequently prevails in our prisons, and that seems often to originate in deficient nutriment, is diarrhoea; and in that case it appears to result, like the disorders I have already spoken of, rather from want of some elementary principle, than from mere starvation. If the food be sufficiently varied, and its quantity only reduced, the bowels become confined instead of relaxed. This was well shown in the famous voyage of Capt. Bligh, subsequent to the mutiny on board the *Bounty*, which took place near Otaheite, on the 28th of April, 1789. The mutineers kept possession of the ship, and turned Capt. Bligh and 18 others adrift in an open boat, with a certain quantity of provisions. On the 2d of May, in a scuffle with the natives of one of the neighbouring islands, some of their provisions were lost, and their stock was reduced to 150 lbs. of bread, 20 pounds of pork, 28 gallons of water, 5 quarts of rum, and 3 bottles of wine. With this slender supply Capt. Bligh put to sea, steering across the Pacific for New Holland. To make the provisions hold out he placed the men on the allowance of $\frac{1}{25}$ th of a pound of bread and a quarter of a pint of water, three times a day, with occasionally half an ounce of pork and a spoonful of rum for dinner. The weather during the passage was extremely wet and stormy. On the 20th, Capt. Bligh remarks, “extreme hunger was now too evident, but no one suffered from thirst, nor had we much inclination to drink; this desire, perhaps, being satisfied through the skin. The little sleep we got was in the midst of water, and we constantly awoke with severe cramps and pains in our bones.”

On the 25th of May, the supper portion of bread was discontinued. On the 28th of May, they reached, and landed, on the northern coast of New Holland. At this time, Capt. Bligh states, the general complaints among us were “a dizziness in the head, great weakness of the joints, and violent tenesmus; *most of us having had no evacuation by stool since we left the ship.* I had constantly a severe pain at my stomach, but none of our complaints were very alarming.”

On the 30th of May, they set sail along the coast, and on the 3d of June again launched into the ocean. During the six days they remained on the coast of New Holland, they found oysters, a few chams,

and water, and caught a few small diving-birds. They had also good rest at night, and were much refreshed. On the 10th of June, Captain Bligh thus describes the condition of the crew: "an extreme weakness, swelled legs, hollow and ghastly countenances, a more than common inclination to sleep, with an apparent debility of understanding, seemed to me the melancholy presages of approaching dissolution."

On the 14th of June, they reached Cou-pang all living, after crossing a sea of more than 1200 leagues in an open boat.

There are many circumstances of great interest in the narrative; but I have cited it as showing the tendency to constipation produced by diminution in the quantity of food. This renders it probable that diarrhoea, if it result from insufficient nutriment, is to be attributed to some deleterious article, or to the absence of some elementary principle necessary for the support of the body.

This subject receives some elucidation from the experiments of the Paris committee appointed to investigate the nutritive properties of gelatine.

During the French Revolution, when provisions were very scarce, and the poor of Paris almost famished, it was proposed that the gelatine, which enters into the composition of bones, should be extracted from them by means of heat or acids, and formed into soup for the poor.

At first, the highest anticipations were held of this expedient, which, it was supposed, would increase greatly the quantity of nutriment to be derived from animals—or, to use the words of one of its sanguine advocates, would, out of four oxen, create a fifth.

After some time, it was put in practice in the Hôtel Dieu, and some other hospitals in Paris. The bones of the meat used in the house were broken up, and placed into iron cylinders, when they were exposed to the action of steam, at the temperature of about 220°. By this the gelatine was extracted, and it was afterwards used, together with a small quantity of fresh meat and vegetables, to form soup for the sick.

The mortality in the hospital increased, and the medical men soon began to entertain a very unfavourable opinion of the gelatine soup. A commission, comprising all the physicians and surgeons of the hospital, was formed to investigate the subject, and drew up a report in which they stated that the gelatine soup, even in small quantity, and when rendered more agreeable to the taste by the addition of salt and the juices of vegetables, impairs digestion, and causes nausea, a burning thirst, flatulence, and diarrhoea. In consequence of this report, the gelatine soup was discontinued at the hospital.

But the evidence of its ill effects was not

drawn solely from the practice of the hospital. Some members of that commission tried it on themselves, and came to the conclusion that it is not only insufficient for nutriment, but that, in certain quantity, it is positively detrimental to health.

The question excited considerable interest in Paris, and a commission, with Magendie at its head, was appointed by the Institute, to ascertain by experiment the nutritive properties of gelatine.

Their experiments were performed on dogs. They found that for the first day or two the dogs ate the gelatine with avidity, but they soon ceased to touch it, and actually died of starvation, or, when they were kept together devoured each other, leaving the gelatine untasted by their side. The water given them at the same time, they continued to take to the last. The gelatine caused in all of them profuse diarrhoea.

Dogs were next kept on jelly associated with other substances in small quantity. Like the subjects of the former experiment they died of inanition. They all had *diarrhoea*, lost flesh rapidly, and became extremely weak.

The following is one of the experiments. A tall dog, about a year old, was kept on a diet of bread and glue, for 63 days. The most profuse diarrhoea continued all this time. It being then evident that the dog must die if the same regimen were persisted in, he was fed on flesh for four days; which restored his strength, and *put a stop to the diarrhoea*.

It was clearly shown that the loathing which the dogs had to the gelatine was not owing to its insipid taste; because they rejected it just as soon, and it had precisely the same effect, when flavoured with different aromatics.

The committee came to the conclusion, that gelatine is not only insufficient for the nourishment of dogs, but that when given above a certain proportion in their food, it proves positively injurious, and excites insurmountable disgust, and that the diarrhoea, which constantly occurred in these experiments, resulted from the direct influence of the gelatine, and not from the want of some necessary principle in the diet.

A French physiologist, M. Chossat, has since performed some experiments that have led him to an opposite conclusion. He kept pigeons exclusively on wheat, from which other grains and pebbles had been carefully separated, and water. At first the birds grew fat and increased in weight, but at the end of one, two, or three months, they became thirsty and affected with diarrhoea. The thirst increased until they drank seven or eight times as much as they did at first, the diarrhoea became excessive, the birds wasted, and all died from the eighth to the

tenth month of the experiment. At the time of their death, their bones were so thin, and so fragile from want of lime, that they were broken with the slightest effort.

Other pigeons which M. Chossat kept on the same food, *with the exception that he added a little carbonate of lime to their corn*, continued to be well nourished and healthy. He concludes that the diarrhœa in the former pigeons was the consequence of an insufficient supply of lime, and intimates that such might have been the cause of the diarrhœa in some of the experiments of the Paris committee. He supposes that an insufficient supply of lime is a frequent cause of diarrhœa, especially during childhood, when a considerable quantity of it is required for the growth of bones.

It is no doubt dangerous to trust much to analogy in such causes, and to infer because a certain effect has been produced by a certain diet in one animal, that the same effect will be produced by the same diet in another animal of a different kind; but the experiments I have related would certainly lead us to expect that in man, as in dogs and pigeons, diarrhœa might be brought on by restriction to a diet wanting in some necessary principle. It is well known that diarrhœa occasionally prevails extensively in our workhouses and prisons; and the question at once occurs—and it is a question that motives of humanity might prompt us to settle—is it owing in all, or in any, of those cases to the want of some necessary principle in diet?

In some of our prisons where the diet is chiefly bread and water, diarrhœa is common, while in others in which the nominal allowance is nearly the same, constipation is the prevailing complaint. Is this difference owing to the water being soft in the one case; hard, in the other?

The knowledge we have recently acquired of the whole subject of nutrition makes us better qualified to enter on the investigation of such questions; and justifies the expectation that they will not long remain unanswered.

The most striking instance—at least the instance that has excited most attention—of diarrhœa prevailing among prisoners, has been in the Milbank Penitentiary. Diarrhœa seems to have prevailed more or less among the inmates of the Penitentiary from its first establishment; but in the spring of 1823, it extended so much, and the health of the prisoners was so broken by this and other ailments, that the attention of the government and of the country was strongly directed towards it. Dr. Latham and Dr. Roget were appointed to inquire into the state of the Penitentiary, with a view of ascertaining the cause of the disorder, and, if possible, of arresting it. Those gentlemen—and certainly none more fit for the

office could have been selected—investigated the subject with great care, but after an inquiry protracted for fifteen months, left the origin of the matter still in doubt. At the close of their labours, Dr. Latham published a small volume, which contains not only an admirable description of the symptoms of the disorder, but is besides replete with enlarged and just views of pathology. The book will perhaps never be extensively read, but it will be regarded as the work of an accomplished physician, and may well serve as a model to those engaged in similar inquiries.

Dr. Latham commences his account of the state of the Penitentiary from July 1822, when the dietary of the prison was changed, and the animal part of it reduced almost to nothing.

“During the following autumn, the general health of the prisoners began visibly to decline. They became pale and languid, and thin and feeble. Those employed in tasks requiring much bodily exertion were unequal to the same quantity of work as formerly. Those at the mill could grind less corn; those at the pump could raise less water.” But notwithstanding this remarkable depression of the general health, there appeared among them no manifest signs of any peculiar disease until the beginning of February, when a few persons presented marks of scurvy.

Between the 14th of February and the 1st of March, no fewer than 48 prisoners came into the infirmaries, affected chiefly with diarrhœa and dysentery of a peculiar kind. On the 28th of February, when Dr. Latham and Dr. Roget first visited the prison, they found the prevailing disorders to be scurvy, precisely like that which occurs at sea, marked by spongy and livid gums, and petechiæ, and bruise-marks on the skin, especially on the upper extremities—and this peculiar diarrhœa or dysentery. These complaints were found conjoined in most cases, but not in all: there were a few instances of scurvy without disorder of the bowels; and numerous instances of diarrhœa and dysentery where no marks of scurvy had appeared.

But all the patients, whether affected with scurvy alone, with diarrhœa alone, or with both, presented the same constitutional derangement, denoted by a sallow countenance, impaired digestion, diminished strength, a feeble circulation, various degrees of nervous affection, as tremors, cramps, or spasms, and various degrees of mental despondency.

These disorders had spread to such a degree that more than one half of the whole number of prisoners, between eight and nine hundred, were affected with them; but different classes of prisoners were not affected equally. Those longest in confinement suffered most; and the women, more than the

men. It was found too, that the prisoners employed in the kitchens, though belonging to the class which suffered most, were all free from the disease, and that the officers and servants of the establishment enjoyed a like immunity.

A consideration of all those circumstances led Dr. Latham and Dr. Roget to suppose at first that the scurvy and dysentery were different forms of the same disease, and that both originated in the same cause—namely, a diet not sufficiently nutritious for the maintenance of health.

In consequence of this impression, they ordered an immediate change in the diet of the prison. In place of pea and barley soup for dinner, they substituted four ounces of fresh meat and eight ounces of rice daily for each prisoner, and white bread instead of brown; and as the cheapest and best antiscorbutic that could be procured at that season, they ordered for every prisoner three oranges a day, one at each meal.

The condition of the prisoners now visibly improved, and the marks of scurvy rapidly disappeared. At the end of March, there were not more than fifty persons of both sexes on whom any marks of scurvy remained; and on the greater number of these they were so slight as hardly to be detected.

As the scurvy disappeared, the diarrhoea and dysentery also declined, and the general health of the prisoners so much improved, that, in a report drawn up on the 5th of April, the physicians expressed themselves sanguine of the entire restoration of the healthy state of the Penitentiary.

These anticipations, however, were not destined to be realized. Scurvy, indeed, disappeared, not to return; but hardly had the report been published, when the bowel complaint became again more prevalent. By the middle of May it had again pervaded the prison; and by the middle of June almost all the prisoners, those admitted since the change of diet, as well as those longer in confinement, were affected with it.

The disorder of the bowels varied in degree in different cases, from simple diarrhoea to what might be called cholera or dysentery. It was often attended with pains, like those of colic, and more frequently still with a distressing sense of sinking at the stomach.

But it was found, after the disappearance of the scurvy, that the disorder was not confined to the bowels. The pale, and faded, and melancholy aspect of all those affected, or about to be so, gave evidence of more general disorder; which shewed itself more distinctly in a great variety of nervous symptoms, in headache, in cramps, and, in a few cases, in sudden attacks of mania, or convulsions, or apoplexy.

The nervous symptoms were found almost

constantly associated with the bowel complaint; hardly an instance occurring of one being present without the other. From this circumstance Dr. Latham was led to regard them as component parts of the same general disorder. Of this he had additional proof in the circumstance that both the bowel complaint and the nervous symptoms, alike refractory to ordinary treatment, yielded in a very striking and remarkable manner to the same remedy—mercury given to salivation. At first considerable hesitation was felt, and very naturally, in applying so lowering a remedy in a disease presenting such obvious marks of debility; but after all common means had failed in arresting, or even in much mitigating, the diarrhoea, mercury was tried as a last resource, and produced such striking effects, that it was soon given to the exclusion of every other medicine. A few large doses of it in many cases put a stop at once to a diarrhoea that had long resisted all other treatment, and was fast bringing the patient to the grave. It was found also, that as the bowel complaint subsided, the nervous symptoms associated with it subsided as well. The same treatment was in consequence applied to the nervous symptoms, when those formed the chief or the prominent part of the disorder, and it was in all cases followed by the same striking and beneficial results.

The efficacy of the mercury is the more remarkable, as there were no symptoms during life, and no appearances after death, indicating the existence of those inflammatory affections over which mercury is supposed to exert a curative influence. In most cases there was complete absence of fever; the tongue was pale, and moist, and clean; and the pulse not increased either in frequency or in strength. In a few cases, indeed, there was a certain degree of fever; but this never ran high, and after a few days assumed the character of hectic.

On examination after death, the only lesions found in the bowels were a few small spots of ecchymoses, and a few very small round ulcers, scattered indifferently throughout the entire length of the intestines; and even these slight traces of disease were sometimes wanting. In the head nothing attracted attention but the serum between the membranes and in the ventricles, which in some cases seemed in greater quantity than natural.

All the circumstances I have mentioned early led Dr. Latham to the opinion, that the disease was one of *peculiar* character, and that it had therefore, in all probability, some special, *peculiar*, cause.

As the disease continued to spread in the Penitentiary after a plentiful diet was allowed, it was supposed that it might be kept up by some noxious influence peculiar

to the place, and it was consequently resolved to remove as many of the prisoners as possible from the Penitentiary to other places of confinement. In the beginning of August, 120 of the female prisoners were removed to the Ophthalmic Hospital in the Regent's Park, which was at that time vacant; and, between the middle and end of the same month, 200 of the male prisoners were sent on board the Euthalion hulk, which had been fitted up for them at Woolwich. The prisoners, both male and female, selected for removal, were those who had suffered most severely from the disease. The benefit of change of air and situation was immediately obvious in both classes, while no amendment took place in the prisoners who remained at Milbank.

The disease, however, did not entirely subside, either in the Regent's Park or at Woolwich. The prisoners, and especially the women, suffered frequent relapses. The experiment, however, was considered on the whole satisfactory; and, in consequence of a representation to this effect made by the physicians to government, in the month of October, it was determined to transfer all the prisoners, male and female, remaining at Milbank, to hulks fitted up for their reception at Woolwich. Accordingly, on the 14th of November, the women, whose number had been reduced by pardons to 80, were removed on board the *Narcissus*; and between the 8th and 10th of December, the men, reduced to 281, were put on board the *Dromedary*.

The Penitentiary at Milbank was now empty, and the prisoners were divided between the Ophthalmic Hospital in the Regent's Park, and the hulks at Woolwich. I have already remarked, that the men first sent to Woolwich improved more than the women in the Regent's Park. The latter, indeed, did not go on improving for more than a few weeks. Relapses became more and more frequent, and towards the end of November several of them presented the violent nervous symptoms that had before caused dismay at the Penitentiary. In consequence of this, and of the striking improvement that had taken place in the condition of the women recently removed from the Penitentiary to Woolwich, it was thought expedient to transfer all that now remained at the Regent's Park—91 in number—to Woolwich; and accordingly, on the 21st and 23d of January, 1824, they were put on board the *Heroine*, which had been prepared to receive them.

All the prisoners were now on board hulks at Woolwich. They were 635 in number; namely, 468 males on board the *Euthalion* and *Dromedary*, and 167 females on board the *Narcissus* and *Heroine*.

Little amendment took place in the wo-

men that had been removed from the Regent's Park, and severe cases of bowel complaint continued to recur among them. But all the other prisoners, though transferred at different seasons of the year—in August, November, and December—had experienced a striking change for the better, almost immediately on their arrival at Woolwich. The amendment, however, was not permanent: the disease soon recurred with its former characters. In the month of March 1824, it prevailed to such extent among the women on board the *Narcissus*, who had been removed direct from Milbank, that hardly one of them escaped a severe attack of the complaint, in one or other of its forms. The condition of the female prisoners on board both hulks was now so deplorable, that, as affording the only prospect of preserving their lives, as well as in consideration of their severe and protracted sufferings, it was resolved to set them at liberty. This was done gradually, as their friends were found willing to receive them; and on the 18th of June the last of them quitted the hulks.

The men, after their removal to the hulks, suffered much less than the women. They were liable to occasional attacks of diarrhoea, but had no formidable disorder. Instead of being pardoned, like the women, they were distributed among the hulk establishments at Sheerness, Chatham, and Woolwich.

Little is known of the condition of the women subsequently to their discharge. A few of them, whom Dr. Latham and Dr. Roget casually met, had the appearance of health, but were not exempt from occasional attacks of diarrhoea. The men, dispersed among the convicts at Sheerness, Chatham, and Woolwich, soon recovered their health, and, it would seem, made no more frequent complaints than the men with whom they were mingled.

After the disease had been so closely watched, and the circumstances so varied, it would seem, to one who has not felt the difficulties attendant on such inquiries, that there could be little difficulty in discovering, at least, the *general* nature of its cause.

At first the circumstance of its having broken out, or at least spread so as to excite attention, soon after the diet had been much lowered; of its being associated with scurvy, which is acknowledged to proceed from faulty or insufficient food, of its prevailing most in those who had been longest in confinement, while the officers and attendants were as yet exempt from it,—all led to the opinion which the physicians expressed in their first report, and which every one would have formed on similar data, that the disease had its origin in insufficient nutri-

ment. This opinion was strengthened, at first, by the amendment that immediately ensued on the adoption of an improved scale of diet in the prison; but subsequent events showed clearly that an insufficient diet, although it might, and unquestionably did, aggravate the disease, by inducing scurvy, and by lowering the general condition of the prisoners, yet could not be considered its primary or essential cause.

This disease again spread, and indeed became more general than ever, after the diet had been rendered sufficient, and more than sufficient, for the maintenance of health. It affected the prisoners admitted after the adoption of this improved diet, as well as those admitted before. The officers no longer enjoyed an immunity, but several of *those most employed about the sick* suffered the same disease.

After the men were removed to Woolwich, many of them suffered relapses, at a time when their health was to all appearance *entirely* re-established.

These circumstances are all incompatible with the notion that the disease was caused, and kept up, by insufficient nutriment. Another circumstance that gives more than suspicion of a different origin, is the remarkable—one cannot help calling it the *specific*—influence of mercury given to salivation, in arresting it in all its forms. The ill effects of mercury in scurvy have several times fallen under my own notice, and have been remarked by all writers on the subject. Kramer, who was physician to the imperial armies in Hungary in the early part of last century, tells us that of 400 men, affected with genuine scurvy, to whom, on the advice of Boerhaave, mercury was given so as to induce salivation, not one survived. His own experience seems fully to justify the caution he emphatically gives us—“Shun mercury as a poison.”

As mercury is not itself a constituent of the animal frame, and as it exerts a lowering influence on the system, we should expect that it would have an injurious effect in any other form of disease caused by want of some necessary elementary principle in diet. The fact that it was productive of singular benefit in the disease of the Penitentiary, is, then, a strong argument that this disease did not originate in insufficient nutriment. The same circumstance tends to the conclusion that it is not to be ascribed solely to confinement, to want of exercise, or to any other of the depressing influences to which, as prisoners, the inmates of the Penitentiary were subjected.

The efficacy of the mercury, as I have already remarked, did not depend on its counteracting any inflammatory action. In most of the cases there were no inflammatory symptoms, and losses of blood were ill

borne. Dr. Latham observes, “In a few we ventured to try the effect of bleeding from the arm, sitting by the patient while the operation was performed; and thus, perhaps, when four or five ounces of blood had flowed, the pulse would falter, and we were compelled to stop; or we were compelled to stop when hardly a single ounce had been lost. I am sure there was no good derived from this practice, but, with all our cautions, I am not sure there was no evil.”

The constant and marked efficacy of mercury under such circumstances cannot be explained with our present experience of the medicinal properties of this drug, otherwise than by supposing that it counteracted some deleterious agent, or morbid principle, that had found its way into the system. As the disease was confined to the Penitentiary, we could look for the source of such a principle only to emanations from the soil, or from the bodies of those already affected with the disease. The malady, it would seem, depends on some local influence, or it is propagated by contagion.

The opinion that the disease was produced by some malarious emanation from the soil, might seem at first sanctioned by the situation of the prison, on the banks of the Thames, and by the fact that dysentery not unfrequently prevails in marshy districts. But it was justly remarked, in the first report of the physicians, that the dysentery which depends on marsh malaria is usually associated with intermittent fevers, and has occurred only at the hot seasons of the year; whereas the Penitentiary, from its first establishment, has been altogether free from those diseases which marsh malaria confessedly engender; and the peculiar disorder which formed the subject of their investigation, first spread so as to excite alarm at the close of a winter unusually severe. The conclusion was imperative, that if the disorder originated in emanations from the soil, those emanations were of different kind from ordinary marsh malaria, and were evolved under different atmospheric conditions. The symptoms of the disease too, and the appearances observed after death, were very different from those of common dysentery. In the dysentery of tropical climates, and in that which has at times prevailed in marshy districts of temperate climates during the autumnal months, the appearances found after death are very striking and characteristic. They consist in extensive ulceration of the large intestine. In cases that prove fatal rapidly, a great portion, sometimes as much as three-fourths, or even four-fifths, of the mucous membrane, is found in a state of slough. In protracted cases we find ulcerations of like extent, and, at the same time, enormous hypertrophy of the submucous cellular tissue,

rendering the intestine, when emptied of its contents, three or four times its natural weight. These changes are almost always limited, in a very remarkable manner, to the large intestine. The small intestine may be perfectly healthy quite up to the ileo-cæcal valve, while, immediately beyond it, the mucous membrane is almost entirely destroyed by slough or ulceration.

In the disease of the Penitentiary, on the contrary, nothing was found but a few very small circular ulcers, widely scattered, without preference, throughout the entire length of the intestine, and here and there a small spot of ecchymosis. In some cases, even these slight traces of disease were wanting, and no morbid appearance whatever was found but a few small patches more vascular than the rest of the intestine.

These circumstances rendered it clear, that if the disease at the Penitentiary depended on any local influence, this was very different in kind from the ordinary marsh malaria. The recurrence of the disease in a severe form, both in the prisoners removed to the Regent's Park, and in those sent to Woolwich, showed almost conclusively that it was not caused by *any* malarious emanation peculiar to the situation of the Penitentiary. We know, indeed, that persons who have once had intermittent fever are long liable to a recurrence of it at certain seasons, or on any impairment of their general health, without fresh exposure to malaria. But cases of this kind occur only in a scattered manner, and the subsequent attacks are usually milder than the first. The disease, in a regiment, or in any body of men stationed in a malarious district, although it may not entirely disappear, will yet subside on the whole when the men are removed to a healthy station. But the disease of the Penitentiary prevailed more extensively among the female prisoners, and was more alarming after two removes—the first to the Regent's Park, the second to Woolwich—than while they remained at Milbank. All these circumstances, together with the fact that the disease did not cease to recur at any season, if they do not entirely disprove the hypothesis of any peculiar emanation from the soil, at least render such hypothesis extremely improbable.

We come now to the last supposition, namely, that the disease was propagated by contagion.

When we see a disease confined to a particular locality, and there affecting, in succession, great numbers of persons whose previous habits have been different: if we cannot ascribe it to impure air from defective ventilation, or to some moral influence, we are compelled to seek for its cause in unwholesome or insufficient diet; in noxious emanations from the soil; or in contagion.

The physicians who visited the Penitentiary

seem never to have had the notion that the disease could be caused by defective ventilation; and if they had entertained such a notion at first, they must have removed it when they found the disease recurring in the Regent's Park, and at Woolwich.

The prisoners at the Penitentiary were no doubt subject to depressing moral influences, but the same influences are acting on persons sentenced to long terms of confinement in other prisons where no disease at all like that of the Penitentiary exists. The circumstance that the disease affected some of the officers, and others in attendance on the sick, affords additional refutation of the notion that it originated in moral influences. I may again notice, as bearing strongly on the same point, and tending to the same conclusion, the extraordinary efficacy of mercury, given to salivation, in arresting the various forms of the disease.

The supposition that the disease originated in defective ventilation or in depressing moral influences being excluded, it follows, that all those circumstances which discountenance the notion that it was caused by faulty diet or by malaria, are, to precisely the same extent, arguments in favour of the contagious nature of the malady. The fact of the disease continuing to spread—1st, after the diet was changed; 2d, after the prisoners were removed to the Regent's Park and Woolwich—directly points to contagion as its source. Dr. Latham gives more circumstantial evidence to the same effect. He says, "several officers of the establishment were affected, and those especially who were in frequent intercourse with the sick. Twelve male and six female officers suffered the same forms of disease with the prisoners themselves. The chaplain, also, and various members of his family, residing within the walls of the Penitentiary, had the disease in the form of bowel complaint; himself, (as he believed) in consequence of his attendance upon the sick prisoners, and his family, (as he believed) in consequence of a female selected from among the prisoners to become his servant being received into his house, before she had entirely recovered from the disease."

The prisoners admitted into the Penitentiary after the diet had been changed, almost all took the disease; and in them it had precisely the same characters as in those who had been longer confined.

"Three persons employed at the ophthalmic hospital, who had not been at Milbank, suffered disorder of the bowels, under one of the forms in which it had prevailed among the prisoners, that of cholera morbus."

"The female prisoners on board the *Narcissus* had been convalescent during several weeks; when the females from the Regent's Park, of whom several had recently suffered

renewed attacks of their disorder, were removed to Woolwich, and put on board the *Heroine*. Both vessels were moored close to each other, and some women from the *Heroine*, for better accommodation, were transferred to the *Narcissus*. Not many days afterwards, there was a general complaint of illness on board the latter vessel, which terminated in that form of disease which has been described, occurring in the month of March."

All these facts afford strong presumption that the disease was propagated by contagion. But in order to satisfy our minds, the supposition of the contagious nature of the malady should explain, not a few only, but all the chief circumstances noticed; or at least it should not be incompatible with any of them. In the history of the malady, very striking circumstances are—the immediate improvement in the health of the prisoners consequent on the change of diet, and, with one exception, on each removal, whether to the Regent's Park or to Woolwich;—the diseases not becoming general, and, in fact, ceasing to spread, when the prisoners were set at liberty, or distributed among the different dock-yards;—and the frequent relapses to which those who had once had the disease were subject. No theory of the disease can be considered satisfactory that is incompatible with these circumstances; but the supposition that the disease is contagious is not incompatible with either of them.

When the diet was changed, the prisoners had scurvy, and were no doubt otherwise weakened by being kept on a diet not sufficiently nutritious. Improvement in their general condition might therefore have been expected from an amended regimen, even supposing the peculiar disease of the prison to be quite independent of diet.

The improvement that took place at first, when the prisoners were removed to the Regent's Park and Woolwich, and the subsequent relapse, are also explicable on the supposition of contagion, and, I think, on this supposition alone. They improved, at first, when removed from an atmosphere saturated with the contagious effluvia. A similar amendment has often been observed in persons removed in fever. Relapse took place when the atmosphere of their new habitation had been charged with the matter of contagion.

The circumstance that the malady seemed to spread when the prisoners were scattered, is no doubt the strongest point against the supposition of contagion; but it is not incompatible with it. The physicians and attendants on the sick in fever hospitals rarely escape the disease, while in other hospitals, where there are generally fever cases, but those cases few in number and scattered through the different wards,

the attendants are seldom affected. A certain concentration, or accumulation of the poison, seems necessary to infect persons not especially prone to the disease. Erysipelas, again, plainly shows its contagious nature in hospitals, while in private houses it rarely spreads.

The last point to be explained, namely, that the prisoners suffered frequent relapses, seemed to have had great weight with Dr. Latham in preventing him from yielding his belief that the disease was propagated by contagion. The fact seemed to him contrary to general experience; which is, that the convalescents from any disease are incapable of taking it again, from those who are the more recent subjects of it. But this applies only to those contagious diseases that are acute in character and affect a person once, only, in life; which we must suppose, therefore, to involve, and to change in some way, the entire mass of circulating fluids. The contagious diseases, as itch, porrigo, syphilis, that are unattended with fever and pursue a chronic course, do not obey this singular law. A person who has had one attack is not exempt from subsequent ones, and during convalescence, even, may, in the case of the two first diseases certainly, be reinfected not only by others, but also by matter previously derived from his own person. Erysipelas, though attended with high fever, is another instance of an infectious disease, of which one attack affords no security against subsequent ones.

The disease of the Penitentiary, from its chronic course and the absence of fever, is more allied to the latter diseases than the former; and from these characters we might have expected, antecedently to experience, that, if infectious, it would be liable to recur. The frequent relapses, therefore, to which the prisoners were subject as long as they continued in the infected atmosphere, affords no valid argument against the supposition that the disease was propagated by contagion.

All the phenomena of the disease, as recorded by Dr. Latham, are, then, explicable on the supposition that it is propagated by contagion; the contagious matter being evolved slowly, requiring for its full effect a certain degree of concentration, and affecting those, chiefly, who, by insufficient diet, or otherwise, are in a state of debility.

The fact, that we do not recognise scattered cases of the same disease in persons not in confinement, as we do of the other diseases I have cited, is no objection to this view of its nature. Its symptoms are not sufficiently striking or characteristic to enable us readily to recognise them in individual cases, where little is known of the previous history of the patients.

It might have been supposed that if contagious, it would have been earlier known

and acknowledged as such; but this does not necessarily follow. The tendency of modern research has been to increase the catalogue of diseases specific in their nature and cause.

In the absence, therefore, of other evidence, it is prudent to act on the supposition that it is propagated by contagion. But, perhaps, even yet we should be wise to suspend our judgment, and await the fiat of future observation. In all probability we shall not have to wait long. The disease has again broken out at the Penitentiary, and Dr. Baly, who is so favourably known to us by his translation of Müller's Physiology, is appointed to observe it. Much may be expected from his industry and judgment.

If the contagious nature of the disease should be established, the question would immediately arise, what is the character and material form of the morbid agent? Is it one of that group that enter the blood and contaminate the whole system, or else one of that class of parasites, whose known number is every day increasing, which stick to the surface of the body? It has just been discovered that the apthous disease to which children are liable, which the French call *Muguet*, and which by us is comprehended, in common, perhaps, with another disease of different origin, under the term Thrush, is caused by a parasite somewhat like that of the *tinea capitis*. The disease, which usually commences in the mouth, sometimes runs through the whole intestinal canal. The parasites, it would seem, are detached in the mouth, and being freely swallowed, became transplanted below, and thus propagate themselves the whole way down. May not the Penitentiary disease be something of this kind? The singular efficacy of mercury given freely, and which is, as you know, so destructive to organisms of this class, gives some degree of probability to the hypothesis. The secretions of the intestines and the surface of their mucous mem-

brane should be thoroughly examined under the microscope.

A disease somewhat similar, as far as I can gather from reports in the papers, has prevailed in the Union Workhouse at Bridgewater, almost from its first establishment. Not the interests of science only, but, what should touch us more nearly, the well-being of the poor, therefore, are deeply concerned in the discovery of its cause.

On this account, and because from the establishment of workhouses throughout the land, each of you may have to give your opinion on questions of this kind, I have thought that it would not be uninteresting to bring the facts connected with the disease of the Penitentiary before you. The lesson I am most anxious to teach you, is—that questions necessarily so abstruse are not to be settled hastily, or by discussions in newspapers, tainted, as they almost unavoidably are, with the bitter spirit of party; but by a careful analysis of all the facts of the case, pursued in singleness of mind and with the sole desire of arriving at truth.

The history of the disease of the Penitentiary illustrates, what I have already dwelt upon, the specific nature of that morbid change which constitutes scurvy; and the certainty with which it may be cured whatever be the circumstances under which it occurs. When Drs. Latham and Roget were first called to the Penitentiary, they found the prisoners affected with genuine scurvy,—with petechiæ and spongy and livid gums,—as well as with the disease whose history I have given you. They immediately ordered an improved diet, *including three oranges a day*, for each prisoner; and at the end of a month, notwithstanding the co-existence of another debilitating disease, and the continued operation of all the depressing influences to which, as prisoners, they were subject, almost all traces of scurvy had disappeared.

