REMARKS

ON THE

PHENOMENON OF THE NUTRITION OF TISSUES:
WITH AN INQUIRY INTO THE NUTRITIVE
VALUE OF BEEF-TEA.

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ON considering the composition of food, and comparing it with that of the tissues to be nourished, we observe at once that the nutritive material contains albumen, phosphoric acid, potash, and magnesia, which, finding their way ultimately from blood into tissues, are assimilated or fixed, becoming bound together, by means of water, in such a way as to form a solid body, having the same structure and the same composition as the tissue, the waste of which these substances are repairing. I have shewn (see *BRITISH MEDICAL JOURNAL*, February 10th and 24th, 1872) that the constituents of food assume partly the colloid, partly the crystalloid condition (those which are colloid being alone directly concerned in the formation of tissues), and they may be considered as retaining this form after they have been assimilated; but these substances cannot be removed in the process of waste, unless by undergoing a metamorphosis from the colloid into the crystalloid or diffusible state. Muscular tissue acquires this new power of diffusibility from the action of potash, which blood yields to tissues in sufficient quantity, not only to assist in building them up (an extremely small proportion of potash enters into their formation, if they contain any at all), but also to transform the assimilated phosphoric acid into a crystalloid phosphate, thereby causing its elimination by a process of diffusion; at the same time, a phenomenon of oxidation effects the removal of the albuminous portions of the tissue by transforming them into kreatine, kreatinine, and sulphuric acid, these several substances being all crystalloid and consequently diffusible.

Tissues only contain very small and somewhat varying proportions of chlorine, amounting, when calculated as chloride of sodium, to a mean of 0.275 grammes of this for 200 grains of ox-flesh, and about 11 per cent. of the whole of the mineral constituents. This substance must perform some important function in muscular tissue, as it is never absent from it, although it does not actually form part of the assimilated tissue.

Blood must clearly contain the same kind of substances as we find in tissues, but their relative proportion respectively is vastly different, and no connexion can be traced between the composition of blood or of serum and that of the various solid portions of the body. We must therefore completely set aside an old idea that the serum of blood finds its way into tissues for their nutrition by a kind of process of filtration. Indeed, nothing like a filtration is possible through the capillaries, as their walls are so thoroughly impervious and homogeneous that Virchow compares them to a film of collodion. "A film of collodion is not more homogeneous nor more continuous than the membrane of a capillary." (*Cellular Pathology*. By Rudolf Virchow. Translated by F. Chance. P. 113.)

The material for the nourishment of tissues can no more find its way through the capillaries by a process of diffusion, etc., than by one of filtration or transudation, as this material is not diffusible; indeed, I can only obtain about 7.3 of diffusible material for 1000 of blood after twenty-four hours dialysis, and two-thirds of this consists of chloride of sodium, which takes no direct part in the formation of tissue. The colloid substances destined to be supplied to the tissues, therefore, find their way through the walls of the capillary vessels by some process which no known physical law can explain.

The nutritive material, having left the blood, moves about the tissues through a series of small channels, the existence of which Virchow pointed out with the microscope (*Cellular Pathology*). A very simple experiment will shew, not only that these channels exist, but that they really do contain the nutritive material. Let a piece of flesh or raw meat be immersed in water, and this water will be found, after a very short time, to contain albumen, a substance known to be required for the formation of muscular tissue. Now, albumen in solution could not possibly pass from flesh into water if it were not contained in open spaces, because it could not diffuse out of a compact mass, which would then resemble physically a jelly. ("Sur certaines propriétés physiques du tissu musculaire." *Bibl. Univ.* for 1865. By the Author.)

On the Nutritive Value of Beef-Tea.—The nutritive value of beef-tea is most difficult to establish, because we do not know for certain whether the crystalloid nitrogenised compounds, resulting from the changes

which albumen undergoes in tissues, such as kreatine and kreatinine, are or are not converted into urea in the circulation; it is not unlikely that such a phenomenon takes place where there is a deficiency of albumen in the blood from disease, as kreatine can be transformed artificially into urea and sarcosine by a process of oxidation; but in health, under ordinary circumstances, such a change is very improbable, kreatine and kreatinine occurring in the blood in proportions not altogether insignificant, and also in the urine. Beef-tea, as usually made, and free from albumen, contains phosphoric acid, potash, and magnesia, colloid in the necessary proportions to make flesh; most of the phosphoric acid and potash present, however, exists in the form of crystalloid pyrophosphate, and can be, as such, of no use towards the nutrition of muscles. Albumen being withdrawn from beef-tea, the proportion of this substance required to form muscular tissue, together with the other colloid constituents of flesh, must be taken from the blood, which, I may add, contains an infinitely higher proportion of albumen than is necessary to make muscle; the excess, under ordinary circumstances, being obviously transformed into urea and excreted as such.

Supposing blood to contain the minimum quantity of phosphoric acid, potash, and magnesia in the colloid condition, or that which is available for nutrition when death is on the point of taking place from starvation; there will still be present in the circulation a considerable proportion of albumen whose nutritive power can be made available if the blood be supplied with the other constituents (mineral) the tissues require. Hence it is that, by adding to blood the substances present in beef-tea, the tissues are at once supplied with nourishment; and if the crystalloid nitrogenised constituents of beef-tea are, under such circumstances, transformed into urea, it will be readily understood that beef-tea, even free from albumen, may support life effectually for a time.

The retention of albumen in beef-tea, or the addition of some white of egg to the broth, must greatly increase its nutritive value; but, in order to preserve the albumen naturally present in it, we shall require to begin by mincing the meat, and this will have to be extracted with cold or lukewarm water, the fluid being subsequently boiled for a few minutes: this process was recommended by Liebig many years ago, although I question whether it is often adopted. Excellent beef-tea will be best prepared by mincing one pound of the best beef, mixing it thoroughly with a pint of water either cold or lukewarm, then straining and boiling the liquid for a short time, say about five minutes.

The method of immersing one large piece of beef in boiling water, and allowing the whole to boil together for several hours, must yield a very inferior kind of beef-tea, because the outside of the meat, becoming hardened from the coagulation of the albumen, prevents, in a great measure, the actual juice of the meat from passing out into the water. By heating raw meat in a closed space without the addition of water, it loses a certain quantity of its juice, which does not gelatinise on cooling. This material is certainly a highly concentrated extract of flesh, indeed it is the gravy which, under ordinary circumstances, meat gives out while it is being roasted, but it contains no albumen; and, by making beef-tea by extraction with water, as stated above, a much larger amount of nutritive material is obtained from a given weight of raw meat.

As to the absolute quantity of phosphoric acid, potash, and magnesia in beef-tea, it amounts to about one-half of the quantity contained in the whole of the meat after careful extraction; but we are mostly concerned here with the proportion of these substances in the colloid state, which can alone be available for the formation of flesh.* The mean total amount of albumen, colloid phosphoric acid, and colloid potash in 200 grammes of beef (not in the juice in flesh only) I find to be

Albumen (soluble and assimilated)	...	...	33.815
Phosphoric acid	"	...	0.301
Potash	"	...	0.103

while the total amount contained in beef-tea prepared from 200 grammes of raw meat, but free from albumen, will only amount to nearly

Phosphoric acid	...	...	0.037 grammes
Potash	...	...	0.013 "

or one-tenth the quantity originally present in the beef. Now, the albumen required to make flesh with these proportions of phosphoric acid and potash would only be 4.23 grammes, which may apparently be taken from the blood without robbing it to any very serious extent. The clear beef-tea from one pound of meat would, according to this estimation, yield, therefore, only one-tenth of the whole amount of nutritive material which it contains, and no albumen. The proportion of

* The crystalloid phosphate of potash in beef-tea probably acts also a part in the phenomenon of nutrition.

albumen required to make flesh with this beef-tea and which the blood must have to supply would amount to 149 grains (9.64 grammes). Now, twenty pounds of blood would contain (at 90 per 1000) 12,600 grains of albumen; so that blood may be expected to be able to continue supplying albumen to the material of beef-tea to make flesh some time after any food has been taken. This length of time must be regulated by the rate of the formation of urea and that of the waste of tissues.

A CASE OF FEIGNED DISEASE.*

By ANDREW AITCHISON, M.B., Wallsend.

THE history of this case is somewhat obscure; but I shall give it as nearly as I can remember, having heard it from the female who was the subject of disease. The case is rather interesting, as the woman lay in bed for twenty-two years, never being up during that period even to have her bed made. She also vomited for seventeen years matter having a faecal character.

J. H., aged 19 at the time of attack, was seized with a fit in the summer of 1850 while making hay, which the medical man who was called pronounced to be hysterical. From this time, she never was strong. About six months after this fit, she was attacked with an inflammation of the chest, which left her very weak. On recovering from this attack, she attended the Newcastle Infirmary regularly for some time, as she still suffered from hysterical fits; but, as she did not receive any benefit from the medicines she took, and seemed to grow weaker, her medical adviser recommended that she should lie in bed until she was stronger. As she appeared to be no better in bed, she was advised to get up and try to go about again; but this, she said, she was unable to do, so there she remained. About five years after the commencement of her illness, she was seized one day with vomiting and violent pain in the bowels, and at the time the pain was very severe she thought she felt something give way. The pain left in a few days, but the vomiting continued, and no medicine she took relieved it in the slightest.

She came under my father's care, on the death of the parish surgeon who attended her, in the summer of 1862. She then complained of a tightness over the chest with pain shooting through to the back, and a severe cough, occasionally attended with spitting of blood. There was great tenderness over the abdomen. She vomited several times a day, the vomited matter having a very offensive and faecal odour. Her bowels were moved, she said, about once in five weeks. I may as well mention that at each visit the vomited matter was shown, and it always had the appearance of being newly ejected. The stench, also, was unbearable. On examining the patient, no tumour or anything abnormal was discovered in the abdomen. The chest was dull on both sides, and she had all the signs of incipient phthisis. After having tried various drugs with a view to check the vomiting, and seeing that she got no better, but that the sickness seemed to be aggravated by taking medicine, the conclusion arrived at was that the patient might be suffering from gastro-colic fistula, although the case was entered in the pauper-book as one of doubtful character. During her illness she was seen by several medical men to whom I had mentioned the case. Nearly all had some doubt as to where the vomited matter came from, and two said that they did not believe she vomited at all; but as she had been seen to vomit on several occasions, that doubt was removed.

About two years ago, I asked Dr. Philipson to see her with me. He examined the patient and the vomited matter very carefully, and in the vomited matter he found large quantities of cotton-wool mixed with articles of food, and he then expressed his opinion that the patient swallowed cotton-wool in order to cause the vomiting and the peculiar character of the vomit; and that her object was to deceive, in order to obtain sympathy and charity from her neighbours. On being told that she was accused of eating cotton-wool in order to cause the vomiting, she denied it, and said that she would never give herself so much pain as that caused by the vomiting if she could help it. The symptoms continued without variation for seventeen years; and about three weeks before her death she was seized with obstinate diarrhoea, and the vomiting and sickness suddenly ceased. The diarrhoea lasted for three weeks, when she died as from consumption.

After death, I made a *post mortem* examination of the body. Great difficulty was experienced in opening the chest, owing to its sternal portion being firmly bound down by the pleura. The pericardium was firmly attached to the pleura and ribs of the left side, and also to the diaphragm. Both lungs were firmly attached to the walls of the

chest by old adhesion. Both lungs were infiltrated throughout by tubercle, and in the upper lobe of the left lung there existed a cavity of large size. The pericardium was thickened, and contained about two ounces of serum. The heart was exceedingly small. The abdomen was carefully examined. No communication existed between the stomach and colon. The stomach itself was healthy, and of normal size. The liver was enlarged and slightly fatty. The bowels appeared to be healthy throughout, with the exception of a little redness of the mucous membrane. The uterus with its appendages and all the other organs were perfectly healthy. It was very satisfactory after so many years of doubt to find out the true nature of the case. Instead of its turning out to be one of gastro-colic fistula as it had been supposed to be for many years, it was found to be one of hysteria, as revealed by the *post mortem* examination. It is also very remarkable that she should have deceived her friends so long; even her own mother, who waited on her day and night, seemed to be perfectly ignorant of her deception.

ADDISON'S DISEASE.

By JOHN F. NICHOLSON, F.R.C.S., Stratford.

A. W., aged 14, was seized on September 14th, 1871, with vomiting of food and bile. His bowels had been freely moved by effervescing magnesia the day before. His illness could not be traced to any cause except having eaten some ripe red plums. Diarrhoea was epidemic. The vomiting continued more than a week, in spite of the most careful diet and medical care. Turpentine stupes were applied, and ice was freely given. Beef-tea was the first thing retained; brandy and water was most unpalatable. I had ordered it, as his pulse was very low and the exhaustion great. He looked of a dull, leaden hue, reminding me of cholera collapse. His extremities were cold, his tongue clear and red, and he had great thirst. His skin, naturally dark, had on it several black-coloured mole-spots, chiefly on the neck and arms; the lips were not red, but of a dark purplish hue. All the other members of his family were fair and healthy. He had an attack of phlegmonous erysipelas in the left arm in 1860, when two years old; tetanic symptoms set in; free scarification gave relief, being followed by abundant purulent discharge and sloughing of the cellular tissue. He recovered, and had since enjoyed tolerably good health; but his mother said he had always been of a very sensitive nature, and highly emotional. The scar left where I made the incision was now of a dark coppery colour, and his shoulders were also striped with a band of the same dark hue, where they had been chafed by his braces and the basket which he carried as a baker's lad. The genitals were almost black, like those of a mulatto. The mole-spots were perfectly black, melanotic, varying in size from a dot to that of a shilling. His ankles were scarred by marks of the same dirty coppery colour, where his boots had chafed the skin. His bowels were costive; but simple aperients acted well, the faeces being healthy, with abundance of normal bile. His urine was acid, always in all respects healthy, without a trace of albumen. His abdomen was flat, and, on careful examination, gave no positive indications of disease. His sleep was tranquil, but his head swam when erect. The vomiting generally came on when he awoke and attempted to stand; it was preceded by giddiness. Nothing but a little froth or phlegm was voided ordinarily, excepting what might have been swallowed immediately before. He improved a little, but lost flesh rapidly. He was able to take a little mutton occasionally; but beef-tea and milk were the staple articles of his food. There had been no pain in the loins, nor any sense of fullness or tenderness. The tongue remained very clean and moist, the skin generally cold; but his pulse was about 80, and small.

October 8th. Dr. Sutton kindly saw the case with me, and said all the abdominal organs seemed sound; but as to Addison's disease, he felt doubtful. The discoloration he considered too general, the wasting unusual, and the age of the patient younger than any case he had seen in marked disease of the suprarenal capsules. The patient was obliged to keep the recumbent posture; his bowels became more constipated. The saline alkaline aperients suited best; the mineral acids did not agree. A little tincture of calumba, and then of bark, with carbonate of potash and sal volatile, sat best on the stomach.

November 6th. He had improved for the last ten days. There had been no vomiting. The appetite improved; the bowels acted fairly; His complexion was better; but the skin on the back looked coppery; and immediately above each knee there was a streaked space about an inch and a half wide, as if it had been brushed over with a purplish colour. This had been noticed during the last four or five days. He said he was not giddy, and wanted to go out.

March 30th, 1872. He had been able to do a little work in the bake-

* Read before the Northern Branch.