ON THE RELATION OF FOOD TO WORK DONE BY THE BODY;

AND ITS BEARING UPON MEDICAL PRACTICE.

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PART II.

THE foregoing observations and calculations were made in the month of July 1866, but I did not then publish them, as I found afterwards that I had been anticipated by Dr. Fick and Dr. Wislicenus of Zürich, in a paper published in June in the *Philosophical Magazine*, on the urea excreted during an ascent of the Faulhorn. Professor Frankland, in a paper published in the same Journal in September 1866, corrected some erroneous reasoning that found its way into Fick's and Wislicenus' paper, and further supplied, from direct experiment, the *Digestion coefficient* of proteine, which had been obtained by me from calculation. The actual value of this important constant was found by him to be—

Actual value of digestion coefficient of Proteine . . .	4.3155
Calculated value	4.8375

My only object in now publishing an account of the independent experiment and calculation made by myself, is to confirm the certainty of the important fact first proved experimentally by Fick and Wislicenus, that the force due to the urea excreted in a given time is not sufficient to provide the actual work that may be done by the muscles in the same time.

Liebig and his followers, misled by a preconception of the simplicity of nature, assigned to nitrogenous food the duty of providing the force necessary for the production of muscular work, by supplying the waste of muscular tissue; while they supposed the farinaceous and fatty foods to provide the amount of animal heat required by the body.

The opponents of Liebig have fallen into the opposite error, and deny that nitrogenous food contributes any portion of the force employed in muscular work.

The truth, as is usual, lies between the two extreme hypotheses, and we are now compelled to admit that a given development of force, expressed in animal heat, muscular work, and mental exertion, may be the effect of several, perhaps many, supposable supplies of digested food, farinaceous, saccharine, fatty, and albuminous. Just as a given algebraical function may be equated to a given constant, by the use of a certain definite number of values of its variable quantity, so may a given effect of work in the animal body be produced by certain definite, though very different, combinations of various kinds of food, the digestion of which follows each its own law, and develops its own amount of force. The number of roots in our equation of life increases the difficulty of solving it, but by no means permits the acceptance of the lazy assumption that it is altogether insoluble, or reduces a sagacious guess to the level of the prophecy of a quack.

Lavoisier supposed in his earlier investigations that animal heat was developed by the combustion of carbon and hydrogen in the lungs; just as in earlier times it was supposed to be produced spontaneously in the heart, which was imagined to be so hot as even to burn the hand that should imprudently venture to touch it. In like manner, Liebig and his followers supposed the muscular work to be developed in the substance itself of the muscles that were its instruments.

Both of these doctrines are now justly repudiated by physiologists, and the view, proposed, in 1845, by Dr. Mayer of Heilbronn, and recently developed with much ability, by Mr. W. C. Heaton, of Charing Cross Hospital, in the *Philosophical Magazine* for May 1867, that the blood itself is the seat of all the chemical changes that develop force in the body, has gained favour among physiological chemists, and also met with acceptance among practical clinical observers.

Thus the human mind revolves in cycles, and the physicians of the nineteenth century are preparing to sit at the feet of Moses, and learn that the blood of an animal really constitutes its life; whilst South African theologians reject his authority, because he happened to confound a Rodent with a Ruminant.*

No two classes of animals can well differ more from each other than the cats and ruminants, one of which is intended by nature to eat the other. They differ in all respects as to food, the cats requiring a

supply of fresh meat and blood for their health, and the ruminants being exclusively vegetable feeders; yet in both classes we find a great development of muscular power, and of rapid action of muscles, qualities alike necessary to the pursuer and to the pursued. There can be no doubt that muscular work is developed in the cats from the combustion of flesh, and in the ruminants, mainly, if not exclusively, from farinaceous food. It is, however, worthy of remark, that the muscular qualities developed by the two kinds of food, differ considerably from each other. The hunted deer will outrun the leopard in a fair and open chase, because the work supplied to its muscles by the vegetable food is capable of being given out continuously for a long period of time; but in a sudden rush at a near distance, the leopard will infallibly overtake the deer, because its flesh food stores up in the blood a reserve of force capable of being given out instantaneously in the form of exceedingly rapid muscular action.

In conformity with this principle, we find among ourselves an instinctive preference given to farinaceous and fatty foods, or to nitrogenous foods, according as our occupations require a steady, long-continued, slow labour, or the exercise of sudden bursts of muscular labour continued for short periods. Thus chamois hunters setting out for several days' chase provide themselves with bacon fat and sugar; the Lancashire labourers use flour and fat, in the form of apple dumplings; while the Red Indian of North America almost transforms himself into a carnivore, by the exclusive use of flesh food; he sleeps as long, and can fast as long as the puma or jaguar, and possesses stored up in his blood a reserve of force which enables him, like a cat, to hold his muscles for hours in a rigid posture, or to spring upon his prey, like a leopard leaping from a tree upon the back of an antelope.

If the preceding view of the muscular qualities developed by the two kinds of food be correct, important inferences suggest themselves as to the food that should be employed in relation to several kinds of work. Of these inferences, I shall select two examples.

1. The nurses of one of our Dublin hospitals were formerly fed chiefly upon flesh food and beer, a diet that seemed well suited to their work in ordinary times, which was occasionally severe, but relieved by frequent intervals of complete rest. Upon the occasion of an epidemic of cholera, when the hospital duties of the nurses became more constant, although on the whole not more laborious, they voluntarily asked for bacon fat and milk, as a change of diet from the flesh meat and beer; this change was effected on two days in each week with the best results as to the health of the nurses, and as to their power of discharging the new kind of labour imposed upon them.

2. I have been informed, on competent authority, that the health of the Cornish miners breaks down ultimately, from failure of the action of the heart and its consequences, and not from the affection of the lungs called "miner's phthisis." The labour of the miner is peculiar, and his food appears to me badly suited to meet its requirements. At the close of a hard day's toil, the weary miner has to climb by vertical ladders through a height of 100 to 200 fathoms before he can reach his cottage, where he naturally looks for his food and sleep. This climbing of the ladders is performed hastily, almost as a gymnastic feat, and throws a heavy strain (amounting from one-eighth to one-quarter of the whole day's work) upon the muscles of the tired miner, during the half-hour or hour that concludes his daily toil. A flesh-fed man (as a Red Indian) would run up the ladders like a cat, using the stores of force already in reserve in his blood; but the Cornish miner, who is fed chiefly upon dough and fat, finds himself greatly distressed by the climbing of the ladders—more so, indeed, than by the slower labour of quarrying in the mine. His heart, over stimulated by the rapid exertion of muscular work, beats more and more quickly in its efforts to oxidate the blood in the lungs, and so supply the force required. Local congestion of the lung itself frequently follows, and lays the foundation for the affection, so graphically, though sadly, described by the miner at forty years of age, who tells you that "his other works are very good, but that he is beginning to leak in the valves." Were I a Cornish miner, and able to afford the luxury, I should train myself for the "ladder feat" by dining on half a pound of rare beefsteak and a glass of ale, from one to two hours before commencing the ascent.

The excretion of nitrogen by the cats and ruminants is very different, as might be expected from their food. I have ascertained that the urea discharged by a Bengal tiger and a sheep daily, is as follows.

Bengal tiger.....	4375 grs. of urea.
Sheep.....	256 „

It is worthy of remark, and serves to throw light on the meaning of the excretion of nitrogen from the body, that causes but slightly connected with muscular exertion in the ruminants increase amazingly the excretion of urea. Thus I have found the following excretion of urea from a ram during the rutting season.

Ram (rutting season).....	1493 grs. of urea.
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* No reasonable person can fail to perceive the ignorance of the great Lawgiver, who will apply to him the test first proposed by Swift for Homer; Moses, like the author of the *Iliad*, was totally unacquainted with the discipline and doctrines of the Church of England.

This amounts to a *sixfold* increase of urea, which cannot possibly be accounted for by the food consumed at the time, but requires us to assume a certain storing up of force, represented by nitrogenous compounds, which has been going on for a considerable period previous to the rutting season. A similar and equally remarkable storing up of phosphates and carbonates take place, previous to the rutting season, in the ruminants that shed their horns, which in the *Cervus Megaceros* often weigh 90 lbs.

These remarkable phenomena remind us of the maxim of the wise Hippocrates, who recommends moderation in the use of the gifts of the Golden Venus, as well as in those of Ceres and Bacchus—

πῶτον, σιτία, ποτὶ, ὕπνος, ἀφροδίσια μετρία,

with which may be compared its converse in the Latin proverb—
Sine Cerere et Baccho, friget Venus.

Application of Theory to Diseased Conditions of Body.

The relation of food to work, complicated enough in health, becomes more so in disease, and the problem to be solved by rational theory becomes still more difficult. I cannot attempt even to sketch an outline of this part of my subject considered in general, but shall content myself with asking your attention to three remarkable examples of disease which illustrate the principles I have attempted to lay down.

These diseases are—

- A. Typhus fever.
- B. Cholera Asiatica.
- C. Diabetes mellitus.

A. Typhus Fever.—In typhus fever a prominent symptom is the remarkable elevation of temperature accompanied by an increased excretion of urea and carbonic acid, by the kidneys and lungs, indicating (as no food is taken) an increased morbid metamorphosis of the blood and tissues. The temperature frequently rises to 104 deg. Fahr., representing an increase of upwards of 5 deg. Fahr. above the normal temperature.

If we knew the cause of this increase of temperature, or rather of the increased metamorphosis of which it is the sign, we should know the cause of typhus fever, and learn to combat the disease on rational grounds. At present the cause is unknown, and therefore the physician is forced to treat the symptoms as they appear, instead of attacking the cause of the disease. Let us examine for a moment the terrible significance of the symptoms.

Your patient lies for nine or ten days, supine, fasting, subdelirious; the picture of weakness and helplessness; and yet this unhappy sufferer actually performs, day by day, an amount of work that might well be envied by the strongest labourer in the land.

The natural temperature of the interior of the body is 100 deg. Fahr., while the temperature of the corresponding parts in typhus fever is at least 105 deg. Fahr. This seems at first sight a small increase—only 5 per cent. of the whole; but it is in reality two and a half times as great as it appears, and actually amounts to $12\frac{1}{2}$ per cent., or *one-eighth* part of the total animal heat. For the total quantity of heat given out by the heated body is proportional (from Newton's law of cooling) to the elevation of its temperature of equilibrium, towards which it tends. If we suppose this equilibrium temperature to be 60 deg. Fahr., then the quantities of animal heat given out in typhus fever and in health will be in proportion of 45 to 40, showing that the animal heat of typhus exceeds that of health by *one-eighth* of its amount.

We have already seen that the work due to animal heat would lift the body through a vertical height of eight miles per day; and it thus appears that an additional amount of work, equivalent to the body lifted through one mile per day, is spent in maintaining its temperature at fever heat.

If you could place your fever patient at the bottom of a mine, twice the depth of the deepest mine in the Duchy of Cornwall, and compel the wretched sufferer to climb its ladders into open air, you would subject him to less torture, from muscular exertion, than that which he undergoes at the hand of nature, as he lies before you, helpless, tossing, and delirious, on his fever couch.

The treatment of this formidable disease in former times consisted of purging, vomiting, and bleeding the patient, with the view of eliminating an imaginary poison, and so helping nature to terminate the disease. In modern times, thank God, the physician either does not interfere at all, or adopts the rational process of retarding the disintegration of the tissues consumed to supply the fever heat, by furnishing in their stead, fuel, in the form of wine and beef-tea, sufficient to maintain the increase of temperature imperiously required. This practice may be justly considered rational, because the condition of the circulation admits of its application; and it is considered good, because it has been rewarded with success, in the hands of the skilful clinical physician. In concluding this sketch of the prominent symptom of typhus fever, and as an illustration

of the eagerness with which every possible combustible in the body is made use of, I may mention, on the high authority of Dr. Stokes, of Dublin, that the very urea excreted by the kidneys is not permitted to leave the body without first paying its tax to fever, by being burned into carbonate of ammonia, thus rendering the urine of an advanced case of bad typhus fever eminently alkaline.

B. Asiatic Cholera.—This remarkable disease presents, as every one knows, three distinct stages, viz.—

1. The premonitory stage of diarrhoea.
2. The stage of collapse.
3. The stage of consecutive fever.

The stage of collapse exhibits the following symptoms:—Vomiting or purging; muscular cramps; suppression of bile and urine; lowering of body temperature to 95 deg. Fahr.; extreme prostration of strength; extremities pulseless; and face Hippocratic.

When death occurs during collapse, the following symptoms are usually found, on careful examination, in the corpse. The temperature rises to 103 deg. Fahr.; the muscles give out their characteristic susurrus CCC, and exhibit spontaneous movements; the whole train of symptoms producing the effect of a ghastly attempt at resurrection.*

In this disease we have phenomena respecting animal heat, the very reverse of those found in typhus fever; the body performing one vertical mile short of its daily work, instead of one mile in excess. The prostration of strength resulting from this deficient combustion is so great, that death is often caused by bringing the patient to hospital in a cab instead of upon a stretcher, by his walking up a dozen steps into his ward, and sometimes even fatal results have followed a sudden effort to sit up in bed to vomit.

The rise of temperature after death, and the continuance of muscular susurrus and motion, tend to prove that the impeded circulation, which is the prominent symptom in cholera collapse, is due to constriction (probably vasomotor nervous) of the capillaries, in consequence of which the muscles are deprived of their supply of freshly oxidised blood, the result of which is necessarily contraction and cramp, which produces the excessive agony that characterises this disease.

All authorities on cholera, whether their object be to "impede" or to "assist" nature, are agreed that medicines, whether astringent or purgative, are not only useless, but dangerous in the stage of collapse.

It is useless to give alcoholic fuel to restore the loss of animal heat, for there is no circulation to cause the oxidation of the hydrocarbons.

It is equally useless and more dangerous to give opium, to check the remaining purging that exists; for if vomiting have ceased, your acetate of lead and opium pills lie, as if in the stomach of a corpse, and at the termination of collapse, your patient enters upon the consecutive fever, with perhaps a dozen grains of opium in his stomach, placed there like an explosive shell by your ill-timed zeal, and rapidly passes into a comatose condition, from which he never for a moment rallies. His death is always accredited by the Registrar to cholera morbus, and not to opium.

Purgatives and emetics† in cholera collapse effect the same object as opium, but with greater rapidity. In the stage of blue collapse, the chances of life and death are almost exactly equal, and the slightest additional loss of force turns the wavering beam on the side of death. The effects of a brisk purgative or emetic (if they act) upon a patient, unable to climb a dozen steps, or sit up for a quarter of an hour, without fatal syncope, may be easily imagined; and the use of them cannot be justified by any arguments borrowed from right reason.

A remarkable though transient improvement takes place in collapse by the injection of warm water (brought to the specific gravity of serum by the addition of mineral salts) into the veins or bowels; the patient loses the cramps, feels that he is about to recover, speaks to his friends, and often transacts whatever business is necessary; but speedily falls back into collapse. The improvement in his condition is altogether due to the temperature of the fluid injected, which supplies for a brief period the deficient animal heat, permits a partial oxidation of the blood, restores the capillary circulation in the muscles, and so destroys the cramp; and by supplying the deficient work required, removes for the moment the fatal prostration of strength. Anyone who has witnessed the remarkable effects of warm liquids thus injected in cholera collapse must feel that recovery would be certain, if the improvement could by any possibility be made permanent.

Our hopes for the future as to the treatment of cholera lie, as I believe, in the direction of supplying to the body directly its lost animal heat. I have witnessed the happiest results from an injection of warm

* It is startling, on making a *post mortem* examination of a cholera patient alone, and by candle light, to witness, on the first free incision of the scalpel, the hand of the corpse rise slowly from its side and placed quietly across its breast.

† When mustard is used, its conservative effects as a stimulant sometimes counteract its destructive effects as an emetic.

salt water into the bowels, assisted by hand friction of the surface with turpentine and chloroform, and the application of bags of hot salt along the spine: in cases treated in this manner, we may expect to witness cessation of muscular cramp, restoration of perspiration to the skin, with increase of capillary circulation, and finally, to reward our efforts, a return of the excretions of urine and bile; when these reappear, all vomiting and purging cease, and our patient is almost cured.

After recovery, the contrast between the cholera and fever patient is as great as it was during sickness. The fever patient has been over-worked for nine or fifteen days without a suitable supply of food, and when convalescent, experiences a complete exhaustion of strength that lasts for many weeks. The cholera patient, on the other hand, has been prevented from working by constriction of the capillary vessels, caused by the absorption of the cholera poison,* and feels, on recovery, much like a man that has been half drowned, while the fever patient resembles a man that has been half starved: the one is able to return to his work in the course of a few days, the other only after the lapse of as many weeks.

There are two popular superstitions prevalent among medical men respecting Nature, which yearly slaughter hecatombs of victims; viz., that Nature is simple in her operations and beneficent in her intentions; she is often both simple and beneficent, but at other times she is unquestionably both complex and malevolent.

An Egyptian fable informs us, that the votaries of goddess Nature were divided in opinion as to whether she was transcendently beautiful, or hideously ugly; and that, in order to keep up this difference of opinion which suits her purpose, she always wears a thick veil over her face.

"For, with a veil that wimpled everywhere,
Her head and face were hid, that mote to none appear;
That some do say, was so by skill devised,
To hide the terror of her uncouth hue
From mortal eyes that should be sore agrieved;
For that her face did like a lion shew,
That eye of wight could not endure to view;
But others tell that it so beauteous was,
And round about such beams of splendour threw,
That it the sun a thousand times did past,
Nor could be seen, but like an image in a glass."

Before trusting Nature in the matter of cholera, and proceeding to help her, it would be well to inquire whether she intends to cure the patient by her evacuations, or to put him into his coffin. For myself, I greatly mistrust her, and would wish to ask, previous to assisting her, whether she is really my mother, or only my stepmother. Our experience in Dublin has shown that no more effectual mode of shortening life could be devised in cholera than the "eliminant" treatment; and it was accordingly abandoned as soon as tried in that city.

It is much to be regretted that an authority so deservedly held in high repute as that of Sir Thomas Watson can be now quoted in favour of the treatment of cholera by the maxim *similia similibus curantur*. So far as Dr. Watson has informed us, his change of opinion rests upon the statements of others, and not upon his own experience. He has suddenly become an advocate of the castor oil, rhubarb, calomel, and eliminant treatment of cholera, and writes as follows:—"When I last spoke on this subject in these lectures, I stated that the few recoveries which I had witnessed had all taken place under large and repeated doses of calomel, but I could not venture to affirm that the calomel cured them. At present I am much disposed to believe that, by its cleansing action, the calomel may have helped the recovery; and, after all that I have since seen, heard, read, and thought upon the matter, I must confess that, in the event of my having again to deal with the disorder, I should feel bound to adopt in its generality the evacuant theory and practice."

Sir Thomas Watson omits to add that the cases here referred to were only six in number, of whom three died and three recovered; which is exactly what might have been expected if he had not interfered at all.

Cholera from Bengal visits these islands at intervals of about seventeen years, and it is much to be feared that on its next outbreak hundreds of patients will be sacrificed, in obedience to the dogma that asserts it to be our duty to assist nature.

c. *Diabetes Mellitus*.—This disease furnishes us with one of our best proofs that all the chemical changes, by means of which work is produced, take place in the blood and not in the tissues of the body; and, at the same time, an examination of its phenomena explains satisfactorily the regimen and diet which has been found, by experience, most suitable to the diabetic patient. I shall illustrate the disease by a case which was placed under my control, by Dr. Stokes, some years ago.

A young man, aged 20, named Murphy, suffering from fever (enteric?) in November 1859, and, on recovering, became diabetic. He was ad-

mitted into the Meath Hospital in October 1860, where he remained, under my observation, until his death on Jan. 12th, 1861. He was allowed, for nine weeks, to eat as much as he liked of certain kinds of food, which were varied, week by week, to suit his wants, my object being to obtain, if possible, the natural constants of the disease, undisturbed by external interference; the only medicine used, by Dr. Stokes' order, being opium, to produce sleep, and a little kreasote occasionally, to promote digestion. As the details of this experiment have been fully published, I shall confine myself to the final results. His food and excretions were analysed from week to week, so as to determine the total quantities of sugar-forming and urea-producing food, as well as the sugar and urea actually excreted. During six of the nine weeks, the sugar excreted was in excess of the sugar ingested; and the means of the daily excretion and ingestion of sugar were:

Sugar excreted 9753 grs.
Sugar ingested 9321 "

Diff..... 432 "

During two of the nine weeks of observation, the urea excreted was in excess of the urea ingested; and the mean daily excretion and ingestion of urea were:

Urea excreted 1182 grs.
Urea ingested 1349 "

The foregoing facts illustrate strikingly one of the prominent symptoms of diabetes; viz., the canine appetite. The quantity, both of sugar-producing and urea-forming food consumed is more than double what is necessary to maintain a vigorous labourer in perfect health. An examination of the excretions explains the other prominent symptom of diabetes; viz., the complete prostration of strength in the patient, notwithstanding the great amount of food consumed.

In a state of health, food produces three excretions only; viz., urea, carbonic acid, and water. In diabetes, the farinaceous foods appear in the excretions as sugar, and not as carbonic acid and water; and the work necessary to maintain animal heat must be provided altogether at the expense of flesh-food, which is the very form of food least fitted to maintain it.

The diabetic patient resembles a racing steamboat on the Mississippi whose supply of coals is exhausted, and whose cargo furnishes nothing better than lean pork-hams, to throw into the furnace, to maintain the race. It cannot be wondered at that our poor patient, under such disadvantageous conditions, fails to keep in the front.

Let us compare together the minimum of work necessary to keep Owen Murphy alive, with the work actually supplied to him by the food digested.

I. I have already stated that Dr. Ranke found 660 grammes of carbonic acid in the extreme fasting condition, when he weighed 67 kilogrammes. Now, since

660 grammes = 10185.35 grs.
67 kilogrammes = 147.71 lbs.

we find 69 grs. per lb. of body weight, as the minimum excretion of carbonic acid, consistent with continued life.

This quantity of carbonic acid represents a work generated by its production that would lift its corresponding pound of body weight through a height of

$$69 \times \frac{6}{22} \times 8080 \times \frac{9}{5} \times \frac{772}{7000 \times 5280} = 5.716 \text{ miles.}$$

Under ordinary conditions, the greater part of this carbonic acid and work is produced by the digestion of farinaceous food; but since, as we have seen, the farinaceous food is excreted as sugar in the diabetic patient, and therefore does no work at all, the whole of the foregoing work must be done by the digestion of other kinds of food.

I have already shown that it follows, from Lavoisier's experiments (confirmed in a remarkable manner by those of Regnault), that the work done by the combustion of carbon in the body is to the work done by the combustion of hydrogen in the proportion of 9068 to 3024, almost exactly 3 to 1; hence we have the work done, by Owen Murphy, as a minimum in health,

Due to carbon 5.716 miles.
Due to hydrogen 1.905 "

7.621 miles.

This result is somewhat in excess of the truth, for the same reason that the calculated *digestion co-efficient* of proteine is in excess of that found by Frankland from experiment; for the combustion co-efficients of carbon and hydrogen, in organic compounds, are slightly less than when free. If we are permitted to reduce 7.621 miles in the same proportion as in the digestion of proteine—namely, 48 to 43—we shall find:

* Whatever this may be, its period of incubation is forty-nine hours; that of strychnine is twenty-two minutes.

Owen Murphy: minimum of work consists of body-weight lifted through 6.83 miles.

Let us now compare this minimum with the work actually performed by him when suffering from diabetes, by the digestion of flesh-food and production of urea.

2. I have already shown that the work produced by the formation of 501.28 grs. of urea is 704 foot-tons, by calculation from the composition of proteine and urea. This result should be reduced in the proportion of 48,375 to 43,155, in order to obtain the work given by Professor Frankland's experiments. Making this reduction, we find that 500 grs. of urea correspond to 626.3 foot-tons of work, or 100 grs. urea to 125.26 foot-tons; or, in other words—

Every four grains of urea excreted correspond to five tons lifted through one foot.

Owen Murphy excreted, on an average, 1182 grs. of urea daily during nine weeks; which, by the foregoing rule, are equal to

$$1475 \text{ foot-tons} = \text{Murphy} \times x;$$

where x represents in miles the height through which the patient could be lifted by the work done per day; and is equal to

$$x = \frac{1475 \times 2240}{93.66 \times 5280} = 6.69 \text{ miles.}$$

This result is almost exactly equal to that already found as the minimum consistent with continued life, and explains in the most satisfactory manner the complete prostration of the patient, notwithstanding the consumption and digestion of more than double the usual quantity of flesh-food.

In corroboration of the foregoing conclusion, I may mention that Murphy's temperature was found to be constantly 2 deg. Fahr. below that of other patients (chronic) placed in the same ward, and, in other respects, under similar conditions. His unfavourable symptoms (so long as his powers of digestion were not impaired) were invariably alleviated by the free use of flesh-food and fat, the latter being, instinctively, preferred by him; so much so that, during the delirium that preceded his death for twenty-four hours, he raved incessantly about "fat, roasted fat, which the angels of Heaven were preparing for him."

I have studied many other cases of diabetes mellitus, and found similar results in all; but I feel it to be unnecessary to describe them, as one well ascertained train of phenomena, carefully observed and recorded, is quite sufficient to establish the order of nature.

Conclusion.

I have now, Mr. President and gentlemen, to apologise for the length of time during which I have spoken, and to thank you for the patience with which you have listened to me. I am well aware how much I am indebted to your kindness; for I laboured under two serious disadvantages in addressing you: in the first place, I had undertaken a task beyond my strength; and, again, my address is made shortly after you had, like myself, been charmed and instructed by the luminous, learned, and eloquent oration of Professor Rolleston. I felt confident, however, that I possessed one advantage that he did not; I was a stranger in Oxford, and believed that my faults in matter and style would be leniently criticised. In this expectation, I am happy to say I am not disappointed; and again I thank you for your kindness. Two other advantages I share with him, which have contributed to his address as much as to my own—a profound respect and reverence for all honest labourers in search of truth, whether they have preceded us by twenty years or by two thousand years; and an unwavering confidence and faith in the future that lies before the science of medicine. We traverse a sea, mapped with imperfect charts, carrying with us a sure guide in our compass and stars; but we cannot afford to neglect a single rock or shoal buoyed for us by the skill and care of those that have preceded us. Let us follow their example, and mark with conscientious care, for our successors, the dangers we ourselves discover and escape.

Assembled as we are, within the halls of the University of Oxford, the centre and heart of all that is intellectual and religious in the life of England; an University that borrows its accurate logic, as well as its refined ethics, from the lips of Aristotle; that reverences Euclid as the fountain and source of its elegant geometry; and sits at the feet of Homer, Pindar, and Æschylus, to learn its poetry; we need not fear that Hippocrates and Galen will ever want admirers and students; but the Oxford of to-day has taught us, what many did not anticipate, that she is equally ready and skilful, as she has proved herself to be in cultivating literature, to devote her vast intellectual energies to the encouragement and development of the natural sciences, based upon the solid, and only permanent foundation of mathematical research. The efforts made within the last few years by Oxford, to encourage within her walls the mathematical and natural sciences, have won for her the respect, and warmed towards her the hearts of all that search for truth in the study of

nature. Our brothers in Oxford, like the Athenians at Syracuse, have gone on board the fleet, while we watch them from the shore, sympathising in the sea fight; as they win, we shout; when they fail, we weep.

Long may the union of the far distant, but never to be forgotten past, with the living present, that now exists in Oxford, continue. No science, no profession, can benefit so much by it as that of medicine.

ON CEREBRAL EXCITEMENT FROM THE HEAT.

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THE object of the following paper is to attract attention, not to severe cases of sun-stroke, but to symptoms of less severity which are by no means uncommon, though an unusual and novel affection in this climate, and are to be attributed to the same cause as sun-stroke—the excitement of the brain and the disturbance of its circulation by the long-continued heat of the weather. These cases are attended with pain in the head, giddiness, faintness, fear of dying, chilliness and shivering, and often with palpitation of the heart, irregular pulse, and distressing nervous and mental sensations and delusions, which, from their similarity, are liable to be mistaken for hysteria, or "nervousness", or "biliousness", whilst the real cause is overlooked.

Before relating instances of the milder affection, I will begin with a serious case of sun-stroke, which shows that the less severe cases are of the same family.

CASE I.—On July 16th, George Reed, a strong labouring man, aged about 35, was brought in a cart from a corn-field four or five miles off, in an unconscious state, to the Infirmary. He had walked into the town for provisions; and, when walking with his hat in his hand (as he afterwards described), felt the sun strike the top of his head, and fell down in a state of insensibility. On admission, he was maniacal, tearing out his hair. His head was immediately shaved, and ice in bladders constantly kept to the scalp. Mr. W. Shorto, the house-surgeon, also put ten grains of calomel on his tongue, followed in four hours by a black draught; and gave him salines with tartarised antimony every four hours. During the rest of the day and the night, he continued unconscious and delirious; but the next morning he was sensible, but complained of intolerable pain in his head. He told the nurse that his violence in the night was from the intense feeling of heat in his head making him anxious, in his delirium, to get into cold water. He referred the pain to his vertex. The leeches and purgative were repeated on the 19th; and as his pulse became slower and cerebral, and he still complained of pain in his head and sleeplessness, one grain of calomel, with one-sixteenth of a grain of tartarised antimony, was given every four hours for two days, with improvement. On the 22nd, as he could get no sleep, and still complained of pain in his head—lying, as he always did, on his back, with his neck stiff, knitting his brows, with closed eyes, and with a distressed, fretful expression—I ordered ten grains of bromide of potassium every four hours, which certainly, in many cases, acts as a cerebral sedative; and on the next day his expression was quite altered. For the first time, he expressed himself as feeling better, and from this time he gradually improved; but it was a fortnight before he could get natural sleep. He continued the bromide until August 5th, and was discharged on the 13th quite well, but looking as if he had recovered from a severe illness.

The protracted sleeplessness in this case, and in other slighter ones, in which the heat and pain in the head and vertigo indicated cerebral congestion, is in accordance with the views of Mr. Durham, who has so clearly proved by experiment and physiological reasoning that the brain is anemic, and not congested, during sleep—a doctrine which is in complete accordance with the sleeplessness of delirium tremens and other brain-affections, on the treatment and management of which it throws much light.

CASE II.—A lady, aged about 30, with two young children, strong, well-made, stout, and unused to illness, whilst walking in the street, a fortnight ago, was suddenly seized with pain in the head, giddiness, faintness, and a sensation as if she should die. She drove to my house on her way home, looking so ill that I hardly recognised her. I saw her once subsequently; but she was under the care of my friend Mr. Fowler. She was very ill for nearly a fortnight, with sleeplessness, disturbed nights, anxious fearful days; with occasional aggravated attacks of pain in the top of her head, which was hot; confused vision; vertigo; sickness; loss of power in her limbs, as if paralytic; palpitation of the heart; and irregular quick pulse, with a sensation of coldness of the body, and often a distressing anxiety, as if she were going to die. We agreed, besides quiet, cold to the head, and aperients, to give five grains of bromide of potassium every three hours, which she took for four or five