Do not these facts present invaluable suggestions for the treatment of the class of diseases involving exalted excitability? Might not the hydrophobic patient even, who infallibly dies if exposed to sources of excitement, survive if it were possible to preserve him from all excitement *absolutely?* One thing is certain, the physiological facts and principles which I have unfolded suggest the *principles* on which all our *treatment* is to be conducted.

An interesting question presents itself. How are poisons eliminated from the system? or, on what principle do their effects subside? Some facts, which it would be out of place to detail on this occasion, lead me to think that some poisons, whilst they are removed in all the secretions, are especially separated by respiration. The subject is full of interest, and calls for investigation.

I may here ask another interesting question,—What is the difference between the phenomena of hydrophobia, which is a poisoned condition of the blood, and tetanus, which results from injury of an esodic nerve? The *origin* of the two diseases is essentially different. Are the phenomena so too; and in what degree, and in what respect?

It has been shown that the tetanoid state induced by strychnine is one of poisoned blood, acting on the spinal centre, inducing there exalted excitability, but not necessarily, or without an excitant, a state of tetanus or spasm. The case is tetan*ode*, a state *full* of tetanus, without being tetan*ic*.

I have now to state that tetanus—traumatic tetanus—is more than a mere augmented or exalted excitability. There is, in addition, a constant *excitant* in the wounded irritated nerve. There is therefore constant spasm. But there *is*, also, exalted excitability, and this spasm is exasperated in paroxysms on the application of any other excitation.

The effects of strychnine, hydrophobia, and other congeneric affections resulting from poisoned blood, are *inter*-mittent; tetanus is *re*-mittent only!

Teething, and all those cases of epileptoid disease in which the chief exciting cause, though it be an excitant of the nerve, is *inter*mittent, also leads to an *inter*mittent form of disease.

Have I convinced you, gentlemen, by these observations, of the *value* of these investigations in *practice?* Have I not put into your hands the clue of Ariadne, to lead and guide you through this labyrinth?

In my next lecture I propose to bring before you two most important pathological laws, to which I, at least, can detect no exception:

The first—that no disease of the cerebrum or cerebellum *can* induce *spasm*, except through excitation, by contact or counter-pressure, of the spinal system.

The second—that no disease of this system, wherever situated, if limited to this system, *can* affect the cerebrum, except through the nerves, and muscles, and veins, of "The Neck"—that *medical region* to which I have recently and earnestly called the attention of the profession.

Before I close the present lecture, I beg to notice a remark which has been made to me, upon a statement made in my former one. It was said that I had done injustice to the late Professor J. Reid, when I stated that he had spoken of the action of the superior laryngeal nerve, in the excited closure of the larynx, as being "sentient."

Nothing would grieve me so much as to misrepresent and depreciate the opinions of any of my professional brethren. *This I have never done.* I cannot say that I have never been the subject of misrepresentation and depreciation; for, as I have already said, the race of the Primeroses and of the Parisanuses is not yet extinct amongst us. But most of all I should regret any such act on my part towards Professor J. Reid, whose memory I respect, and whose labours I place in the very first rank in physiology; for if they do not rise so high as to be entitled to the designation of *discovery*, they certainly present a series of new and invaluable results, and especially the papers on the pneumogastric nerve. But I will read to you the paragraph, which I quoted from memory in my last lecture. You will perceive that the very term sentient, or at least "sensitive," is used as I quoted it.

"When any irritation is applied to the mucous membrane of the larynx, in the healthy state, this does not excite those contraction of the muscles that approximate the arytenoid cartilages, by acting directly upon them, through the mucous membrane, but this contraction takes place indirectly, and by a reflex action, in the performance of which the superior laryngeals act as the *sensitive*, or afferent nerves, and the inferior laryngeals as the motor or efferent nerves."—(Dr. J. Reid's "Researches," 1848, p. 251-2.)

The last proof, that the phenomena in question do *not* depend on sensation, if such proof were required, which it is not, is afforded by the testimony of patients afflicted with paraplegia. When this malady is complete—when, as in a case which I recently attended with Mr. Edwards, of Queen-street, Cheapside, the spinal marrow is absolutely *divided* by the disease,—when *all* sensation and all voluntary motion are extinct,—these diastaltic actions exist in their full force, the patient *seeing* the movements induced, but not having the slightest power to *feel* or to *control* them.

I have witnessed many cases of the same kind. The proof is absolute, and the lengthy controversy on this point may be considered as terminated.

I have been favoured by another criticism from a fellow of this college, whom I beg leave to thank, both for the kind terms in which he has spoken of my former lecture, and for his able and learned suggestion. The latter relates to the term which I employed at that lecture. Of opinion that the term "diastaltic" is a happy substitute for the former term "reflex," this friendly writer suggests the use of other compounds of στελλειν in the place of the terms esodic, exodic, &c. It would certainly be desirable to preserve uniformity in our nomenclature; and the kind suggestion, for which I beg to offer my sincere thanks, shall receive my most mature consideration. But I think both terms must be preserved: for example, I do not see how we could express by any compound of στελλειν the idea conveyed by the term panthodic.

THE

Gulstonian Lectures.

Delivered before the President and Fellows of the College of Physicians, April, 1850.

By THOMAS KING CHAMBERS, M.D.

ON CORPULENCE.

Lecture I.—Part II.

The additions to an adult's bulk chiefly due to fat; practical application of this fact. Origin of the fat; partly found ready made in the food; partly formed from other proximate elements of the food; possibly, but not probably, from the other tissues of the body. Circumstances under which fat forms capable of being included in one common law. Superabundant diet, if digested. What digestion is. Effect of deprivation of light and deficient exercise in causing deficient excretion of carbon.

A contemplation of the adaptation of means to their end in every part of creation, a review of the final causes of God's works, is one of the sweetest resting-places for a philosophic mind. But we must not stay too long there, nor think it the end of our mission. The investigation of final causes, says Lord Bacon, shrewdly, is like a nun professed; it exists to God's honour, but it is barren—"tanquam virgo, Deo consecrata, nihil parit."* We must proceed to facts more fruitful of operations and inventions for the physical comfort of mankind.

Before an animal arrives at its full growth, the muscles and bones are or ought to be receiving daily additions to their substance over and above that quantity which they part with by interstitial absorption. But when the period of complete size is attained, but little further increase of the essential organs of motion takes place. The continual and exclusive use of a single muscle or set of muscles may, it is true, augment them appreciably in size; the deltoid of the blacksmith and the gastrocnemius of the runner may be prominent, but these few ounces or pounds make little alteration in the weight of the whole body. Hypertrophy to a singular extent even may exist in the whole muscular and bony framework of the body without any proportionate increase in weight, any increase at all similar to what we find in obese persons. The cast before us was taken from the hand of a French gardener, who lived near Lisle, and presented in his tastes a singular contrast to the apparent destination of his body. Those enormous coarse fingers were famous for their skill in tying up ladies' bouquets. This hand measures eleven inches and a quarter round the palm, eight inches and a half round the wrist, and the thews of the whole man were proportionate; his forearm measured thirteen, his calf seventeen inches, and his strength was very great; yet he weighed, clothes included, but sixteen stone. Compare this with the weight of some small-boned, small-muscled, but obese persons in the table

* De Augmentis Sci. iii. 5.

of obese persons before us, and the difference in the increase caused by fat and more solid structures is strikingly shown. There is a man, small-handed and small-muscled, slim in his youth, who now weighs twenty-seven stone and a half; his height is five feet seven inches, and the average weight of robust men of his height is ten stone four pounds. This body, therefore, probably bears seventeen stone of adipose tissue.

A permanent increase in the weight of a healthy adult animal may be safely considered to be due to fat deposited in some part. I say *permanent* increase, because the absorption of water to the extent of some pounds may, under peculiar circumstances, make sometimes a variation in the weight. When, then, a young animal grows heavier, it may be partly owing to additions to its bone and muscle, and not necessarily to improved condition, but when an adult animal does so, we may assume as a general rule that it has formed adipose matter to the extent of the increase.

This fact has not been sufficiently borne in mind by some of those who have attempted to test the value of different aliments. We find in the experiments made at the Glasgow Bridewell, as recorded in the Report presented to Parliament in 1840,* that classes of men and boys promiscuously mingled, are put upon certain diets, and the mean increase in their weight taken as a proof of the efficacy of the food in fattening. The consequence is, that the experiments prove nothing, but yet they are occasionally made the basis of fallacious arguments on this vital question. Even Professor Liebig fell into the same snare in selecting for the medium of his experiments a goose which had not come to its full growth.†

In our own species, we have an excellent test for the quantity of fat contained in the living body in a comparison of a man's weight and height. If a man considerably exceeds the average weight of others not taller than himself, we never find this large excess due to muscle or bone, but to adipose tissue.

Whence comes this fat which constitutes the permanent increase in bulk of a full-fed adult?

Is it taken ready made in the food?

Is it formed from other alimentary principles?

Is it formed from the decomposition of other tissues of the body?

First. Is it taken ready made in the food? It is a notion which suits well the dignified rank in creation which we usually assign to animals, to represent them as spared the laborious task of preparing the substance of bodies, and as finding all the materials ready formed in vegetables. The higher form of life which is given to the sensitive part of God's work seems to fit it to be the architect and master-builder of the forms for which the humbler plant supplies the material. The idea is said to have been first enunciated by Beccaria of Bologna, in the year 1742.‡ At least, it is certain that he points out the strong resemblance which the gluten of wheat bears to muscular fibre, and the similarity of its mode of putrefaction to that of the animal matters in the urine. And then he adds, "Is it not true that we are formed of the same matters which serve as our nourishment?"

This opinion received very strong evidence in its favour from the discovery of substances identical with the tissues of the body in all articles of aliment. Vegetable fibrin, albumen, and gluten, were discovered. Fat or oil was long known to exist in small quantities in a great many of the articles of food, perhaps in all; and when the analyses of MM. Dumas, Boussingault, and Payen, ascertained that these quantities were not mere traces, but made a considerable fraction of the whole bulk, the conclusion was immediately formed, that all the fat of the animal body was derived from this source. The large proportion discovered by these chemists in all those vegetables which have been found the most rapid fatteners of stock of different sorts, afforded a ready explanation of their economical value.

Thus, maize, which is used to fatten the ancient Roman§ luxury of the large-livered goose, at Strasburg, was found to contain in 100 parts, 8·75; bran, so useful to the feeder of swine, 4·65; oat-straw, much used by graziers, 5.1. Artificial diets constructed in imitation of these natural fatteners, are also found admirably suited to the same purpose. Poultry are fed in some parts of the country on a mixture of bran and

* Fifth Report of Inspectors of Prisons, iv.—Prisons of Scotland.
† M. Persoz, in Annales de Chimie et de Phys., vol. xiv.
‡ Histoire de l'Académie de Bologna. Collect. Acad. xiv. 1, quoted by Dr. Thomson, of Glasgow, On the Food of Animals, p. 158.
§ Martial Epig., xiii. 58—
"Adspice quam tumeat magno jecur ansere majus!
Miratus dices, hoc, rogo, crevit ubi?"

suet, and amply repay the expense of their food, by rapidly attaining perfection. The oil-cake, of which we hear so much from our farming friends, bears a price almost exactly proportionate to the quantity of oil it contains.

A similar deduction may be made from the experiments of Dr. Stark, who in 1770, at the instigation of Sir John Pringle, performed a series of most zealous and self-denying experiments on his own person. He used to weigh himself while living on different articles of food for long periods, in order to ascertain their dietetic value. He found that a less quantity of suet was required to make up for the waste of his body than of any other sort of ordinary food, and that its power in this respect was to the lean parts of meat as three to one. Such, at least, is the inference to be drawn from the MS. account of his experiments left behind him after his melancholy end. In them we find that to keep up the weight of his body it was necessary to add but four ounces of suet to his allowance of bread, whereas a pound of lean beef was required for the same purpose.*

It is hardly possible to doubt that in these cases the fat is taken ready-made into the system, and deposited with but little change in the adipose vesicles. This view is certainly a very simple one, and, if it is the whole truth, the quantity of fat fixed or secreted by an animal will be represented almost exactly by the substances soluble in ether and alcohol but insoluble in water, which make a part of the forage consumed.

But, on the other hand, the formation has been described by Dr. Liebig as a modification of those principles of ternary composition, which enter usually in a large proportion into the nourishment of herbivorous animals.

Starch, sugar, gum, sugar of milk, may, on this hypothesis, be changed into fatty bodies, by losing, under the influence of the vital force, a part of their oxygen.

Dr. Liebig then, we see, answers in the affirmative our second question, as to whether fat may be formed from other elements of the food besides the oleaginous.

The researches of chemists in their laboratories have done much to strengthen this last view. Under the influence of putrifying cheese sugar undergoes a kind of fermentation, which results in the formation of butyric acid. Valerianic acid, which M. Chevreul discovered first in porpoise blubber, is found to be also formed during the decomposition of beet-root, potatoes, and wheat. In the fermentation of sugar for the manufacture of brandy is formed an oil called by distillers füsel oil, which contains margaric acid.† When sugar-canes are stored in warehouses a waxy substance sometimes forms in them, which much diminishes their value, as showing that their contents have partially undergone decomposition. But the most beautiful instance of this transformation occurs in nature. While the fruit of the olive tree is forming, the sap of the stem is sweet and full of starch; it continues so till the product, which makes the tree valuable, begins to swell the berries: then, in exact proportion as the oil is elaborated, the saccharine matter decreases in that which supplies the nutriment to it. When the harvest is ready, not a trace of sweetness remains.‡

These instances are evidence of the possibility of changes occurring of a less simple nature than had been suggested, and of the capability of other elements of food for conversion into fat.

Between the two extreme opinions, of which the one views the fat already formed in the aliment, while the other considers it to be elaborated in the blood, there is room still for a third. Sugar, starch, and the substances related to them may, by the action of some of the secretions of the body, undergo in the intestines a fermentation similar to that which we have above described: they may be converted into fat before they are taken up by the lacteals.

This conversion would take place within the boundaries of the individual body indeed, but still external to its actual substance; in the range of its action, but still not the vital act of one of its parts.

Now, if this opinion be the correct one, animals will still fatten best on oleaginous food, because the lacteals will not then be dependent on the cookery of the stomach, and of the other viscera, to prepare their food for them, but will take it ready made. But still, when starch or sugar is supplied to them in abundance, with but a small quantity of oily matter, they will be able to increase that quantity, and, like faithful servants, return us our own with usury.

We should expect, *à priori*, that a small quantity of oil would be required to commence the action; that is quite ana-

* Dr. William Stark's Works, page 141. Exp. xvii. & xviii.
† Hoffmann, Grundlinien der Physiolog. Chemie.
‡ Schleiden's Botanik, bd. i. p. 183.

logous to what we know of other fermentations, both from manufactures and the laboratory of the chemist. We should anticipate this *a priori*, and our anticipations are quite justified by experiment.

We have the highest authority for learning wisdom from the bees, and here is a case where we may gain physical as well as moral knowledge from their doings. Huber and Gundelach* had stated that bees possess the power of forming wax from sugar. Others, however, on trying the experiment of shutting bees up with loaf sugar, could not succeed in getting them to construct their comb, and, therefore, these statements were discredited. The bees, when thus restricted to the use of pure sugar only, either would not build at all, or else made so little wax, that the quantity might be easily accounted for by that which they naturally retain in their bodies. But MM. Dumas and Edwards,† conjecturing that possibly these failures might arise from the unnatural position in which the bees were placed, put the matter to the test in a different way. They first ascertained how much wax, on the average, is contained in the body of a bee, and then how much wax in honey. Then the swarm was shut up in a closed hive, and supplied, not with sugar, as the others had been, but with their natural food. The animals continued to be industrious; but instead of constructing only so much comb as might be derived from the wax of their bodies added to the wax of the honey, that which they formed was three times as great as could be thus explained. There could be no other source of this additional creation than the sugar of the honey, and from that we must conclude that it arose.

The fattening powers of sugar in health is known to all by the instance quoted by Galen, of the slaves in Italy, who got fat during the fig and grape season,‡ and a similar observation made on the labourers among the canes in the West Indies. I have heard too, that the starved natives of New Holland always get plump during the season when they can procure honey, in which they largely indulge.

These instances induced me to hope that similar good results might follow its use in the emaciation of disease. I persuaded Dr. Cotton to test its power among the out-patients of the Consumption Hospital. But it does not appear to have the same effect on sick people as it has on the healthy, for though it did no harm, yet it did no good.

M. Boussingault and M. Persoz have still further tested the same point in respect to the higher animals, to ascertain whether they too had the power of forming fat from that which does not contain it. They found that in the fattening of geese, the oleaginous matter formed in the body of the bird was more than double the quantity which was contained in the maize consumed. This fact does not depend on one individual experiment. M. Persoz submitted ten and M. Boussingault six geese to a most accurate series of tests by the balance, so that there can be no possible fallacy in the method of observation. The experiments appear to me decisive, and much more so than any performed on the larger animals, from the facility which the method employed, of feeding geese by cramming, affords to administer a certain quantity of even an unpalatable food. Their excrements, too, are much easier to collect than those of animals who make liquid urine, and the amount easier to estimate.

It would appear, too, that not only those proximate principles which contain oxygen and hydrogen in the proportion to form water, (and are therefore easiest consumed by the respiratory combustion,) not only these are capable of being turned into fat, but also the more complex nitrogenous compounds, such as albumen and gluten, have the property of conversion into the same non-nitrogenous class of substances. Wurtz has ascertained that under the influence of alkalies and heat, or by a spontaneous alteration, albumen gives origin to butyric acid, and M. Boussingault has obtained similar results from the allied substance gladiadine.§ And the well-known change of muscular fibre into adipocire, as shown in the facial muscles before you on the table, is an instance of the same decomposition. This consideration would be insufficient without the test of an experiment on an animal; but this additional evidence has been afforded by the industry of M. Boussingault. In two ducks fed on albumen, and in two fed on pure caseine, there was more fat found in the intestines than was to be accounted for by any other supposition than that of its being formed as has been stated.‖

* Naturgeschichte der Honigbiene, 1842.

† Annales de Chimie et de Phys., vol. xiv. p. 400.

‡ Galeni de Aliment. Facult., l. ii. c. 9.

§ Annales de Chimie, vol. xiv. 482.

‖ Annales de Chimie et de Phys., vol. xviii. p. 462.

Animals, therefore, form fat from substances which do not contain it.

Thirdly. But do animals, besides taking fat from plants ready prepared, and making it by the assistance of their secretions from other proximate principles, also find a source of it in the other tissues of their own bodies?

An observation made by M. Persoz would seem, at first sight, to lead to this conclusion. He found that in geese put up to fatten when at their full growth, the increase in weight of the birds was less than the amount of fat formed would have led us to expect—that is, that the whole weight of the animal did not so rapidly augment as the weight of the fat. Thence he concluded that some portion of it was formed at the expense of the muscular fibre. But cannot the loss of muscle or bone perhaps be explained in another way? The birds are evidently in a diseased condition. If not killed at the moment they attain their maximum gravity, they begin to decline, and are reduced with great rapidity, showing that the good condition of the animal in the eyes of the gourmet is an actual state of disease. It is by no means a forced explanation of the above facts to assume, that while the fat was increasing in a morbid degree, the muscles were at the same time wasting from interstitial absorption, and being carried off by the urine. In the same way I would explain that seeming change of muscular fibre and the coats of arteries into fat, which occurs in some cases of atrophy, and is most usual in emaciated persons and unhealthy tissues. The protein compounds may be absorbed and conveyed away from the system as urea, and not being renewed are replaced by the fat derived from the diminishing adipose tissue.

What, then, are the conclusions to which we are naturally conducted by a review of these experiments, and the deductions from them?

We are led to conclude,

First. That the favourite material which nature employs in the production of fat is oleaginous food.

Secondly. That it is formed also from other proximate principles of diet, possibly from all proximate principles.

Thirdly. That there is no evidence adduced to show that it is formed from the other corporeal tissues, but that in unhealthy states of constitution its increase may coincide in point of time with their decrease.

I trust I may be pardoned for recalling your attention to these facts and experiments, of which the details are accessible to all. The conclusions are so important in every point of view, in their practical and scientific bearing, in their relations to physiology, economy, and even politics, that they cannot be too often brought before us; we cannot too often take stock, as it were, of our knowledge on these points.

The next part of the subject which I shall consider, is that which relates to the accidental circumstances under which fat forms in the economy. We have examined what we know of the material cause, now let us see how this matter, the ὕλη of which the building is to be built, as Aristotle picturesquely calls it, is to be brought under the scope of the efficient cause.

These circumstances, varied infinitely in individual instances, are, however, capable of being brought under one common expression. For the formation of fat it is necessary *that the materials be digested in a greater quantity than is sufficient to supply carbon to the respiration.*

I would here remark that by digestion I do not understand merely the mixing of the food up into chyme, which may be designated its second cooking in the stomach; nor yet the absorption of it by the lacteals or veins into the circulation; but I mean the conversion of it into healthy blood. Now it appears that the animal body is capable of taking up for this purpose, from the substances passing through the intestines only a certain quantity at a time of each of the elementary principles of food. You may put as much as you please of that elementary principle into the bowels, you may even drench the circulation with it, but no more than its due allowance of the simple aliment will the blood appropriate to itself. And until it is made into blood, it cannot be converted into carbonic acid and water by the respiration, for the formation of animal heat.

This peculiarity of the animal body seems to afford a ready explanation of the facts ascertained by the French commission of inquiry on the nutritive powers of gelatin. The animals on which the experiments were tried, died in a state of starvation, though they devoured an abundance of starch, or of albumen, or of fat. And why? A certain quantity, and only a certain quantity of each separately, is capable of being assimilated with the blood, and that quantity is less than is wanted to supply carbon for the respiration. For example, in a duck crammed with fibrin by M. Boussingault, there was absorbed into the system, to be assimilated or burnt, in thirteen hours and a half, so much of the said fibrin as would contain somewhat under thirteen grammes of carbon. Now, for the supply of the respiration, to form the quantity of carbonic acid, which the animal gives off by the lungs, in the same time there was required more than sixteen grammes of carbon. It must of course consume its own tissues—in other words, die of inanition.

It is of no use for the alimentary matters to be taken by physical absorption into the body. They cannot be used for respiration unless made one with the blood. Ducks fed for some time upon lard, by M. Majendie, were so saturated with oil, that it exuded even from the ends of their feathers; but for all that, there was an insufficient supply made into the life-giving stream, to prevent the creatures dying in a state of starvation.

But reflect on the altered circumstances of the case, when, in addition to the quantity of fibrin which it is capable of digesting, the blood also receives its allowance of gelatine and of oil. The taking up of a considerable quantity of the one does not offer any impediment to addition of even a superfluity of the others. Then there is enough matter in the blood, not only to supply the lungs with carbonic acid, but to replace the absorbed tissues, and to allow the oil to be deposited as fat. This is the rationale of fattening under the use of a superabundant diet.

On the same principle, if the lungs excrete less than usual, from the want of their accustomed exercise, a similar result takes place. To prepare animals for market we coop them up as much as is consistent with the retention of a certain degree of health, that less carbon may be consumed by the lungs out of the food we give them.

The fattening which arises from want of light may be explained as an exemplification of this law. Mr. Morton took five sheep of nearly equal weights, and fed each with a pound of oats a day, and as much turnip as they chose to eat. One was fed in the open air, two in an open shed, one being confined in a crib; two more were fed in a close shed in the dark; and one of these also was confined in a crib, so as to lessen the amount of exercise it should take. The increase of *live* weight, (which in butchers' language means the weight of the whole animal, not of the quarters only,) and the quantity of turnips they respectively consumed, appear in the following table:*—

——	Live Weight. Nov. 18.	Live Weight. Mar. 9.	Increase.	Turnips eaten.	Increase for each 100 lbs. of Turnips.
	lbs.	lbs.			
Unsheltered	108	131.7	23.7	1912	1.2
In open shed	102	129.8	27.8	1394	2.0
Ditto, but confined in a crib	108	130.2	22.2	1238	1.8
In a close shed in the dark..	104	132.4	28.4	886	3.1
Ditto, but confined in a crib	111	131.3	20.3	886	2.4

A reference to the numbers will show that the sheep left with such a degree of freedom of motion as preserved his health, but deprived of light, made much greater progress, and required less food to make that progress, than any of the others.

We cannot ascribe the condition of the animals to want of exercise, because it may be observed that the sheep which were most closely confined in the cribs did not increase so much, but may with more consistency view it as a result of the deprivation of those chemical changes which we well know are favoured by the sun's rays.

"Perhaps the greatest refinement in fattening is exhibited in the manner of feeding ortolans. The ortolan is a small bird, esteemed a great delicacy by the Italians. It is the fat of this bird which is so delicious; but it has a peculiar habit of feeding, which is opposed to its rapid fattening—that is, that it feeds only at the rising of the sun. Yet this peculiarity has not proved an insurmountable obstacle to the Italian gourmands. The ortolans are placed in a warm chamber, perfectly dark, with only one aperture in the wall. Their food is scattered over the floor of the chamber. At a certain hour in the morning the keeper of the birds places a lantern in the orifice of the wall; the dim light thrown by the lantern on the floor induces the ortolans to believe that the sun is about to rise, and they greedily consume the food upon the floor. More food is now scattered over it and the lantern is withdrawn. The ortolans, rather surprised at the shortness of the day, think it their duty to fall asleep, as night has spread his sable mantle around them. During sleep, little of the food being expended in the production of force, most of it goes to the formation of muscle and fat. After they have been allowed to repose for one or two hours, in order to complete the digestion of the food taken, their keeper again exhibits the lantern through the aperture. The rising sun again illuminates the apartment, and the birds, awaking from their slumber, apply themselves voraciously to the food upon the floor; after having discussed which, they are again enveloped in darkness. Thus the sun is made to shed its rising rays into the chamber four or five times every day, and as many nights follow its transitory beams. The ortolans thus treated become like little balls of fat in a few days."

Here several applications of the same principle occur at once.—Absence of waste from motion, in the extra sleep which the birds get; absence of the usual chemical changes from the influence of light; an unusual supply of food, from their being deluded into taking four meals a day instead of one; and great facilities for digesting that food, by being removed from the view of those external objects which naturally arouse the anxieties, and so hamper the digestion, of waking mortals.

A cruel advantage is taken by the natives in India of their knowledge of the above fact. The wild hog will not fatten in confinement, because he is constantly looking about for some way of escape, and is harassed by the prospect of his prison walls. They therefore sew up the eyelids of the animal, and then he rapidly becomes fit for the table.

We shall see further exemplifications of the same law when we come to review fatness as a disease in the human subject, and shall find pathology in this case, as in most others, to receive its chiefest lights, and the art of healing pain to look or its surest guidance, from rational physiology.

I have endeavoured to select from the advances made recently in this master science—the science of life—such points as are to my own mind indications of duty, though not dogmatical laws. To other minds some will weigh more, and some less, and some, perhaps, which I have omitted, may seem of more importance than they did to me.—"Non tam aliis legem pono, quam legem meæ mentis expono; quam qui probat, teneat; cui non placet, abjiciat. Optarem fateor, talis esse, qui prodesse possem quam plurimis."*

(To be continued.)

* ohnston's Agricultural Chemistry, page 897.

* Petrarch. De vitâ solitariâ.

OBSERVATIONS ON THE ARCUS SENILIS,† OR FATTY DEGENERATION OF THE CORNEA.

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ASSISTANT-SURGEON TO THE ROYAL WESTMINSTER OPHTHALMIC HOSPITAL, CONSULTING-SURGEON TO THE KENT OPHTHALMIC HOSPITAL.

Part I.

General Description.—In elderly persons, a portion or the whole of the margin of the cornea undergoes a remarkable change, and in place of presenting that translucent appearance so characteristic of this structure, becomes, to a greater or less degree, opaque. The opacity may be arciform or zonular. This alteration is not to be, ordinarily, observed until about forty-five or fifty years of age, and then, for the most part, shows itself as a fine curvilinear rim, situated at the upper edge of the cornea. At this time, its colour is not that yellowish or greyish-white which it afterwards assumes, but the cornea, at the part, may be noticed to be simply wanting in its usual lustre and transparency. The inferior part of the cornea is soon, in the like manner, invaded, and a double arc is visible, the concavities of the two being opposed. The breadth of the lower is less than that of the upper arc, and to whatever extent the two may be developed, the same remark, as a general rule, will apply to them. The broadest part is, almost invariably, found to be at the central part of either arc. By degrees, the entire circumference of the cornea becomes opaque, through the union of the cornuæ of the two arcs, and a zone is thus completed. This change is, simultaneously, involving both eyes. To whatever extent, however, it proceeds, it has never been known to interfere with vision; and I have seen it so far extended as to enclose a small elliptical portion only of unaffected cornea, the upper and lower edge of which was opposite to the same parts of a moderately-dilated pupil. The centre of the long diameter of the ellipsis,

† Macula arcuata; gerontoxon; greisenbogen; annular opacity; senile zone.