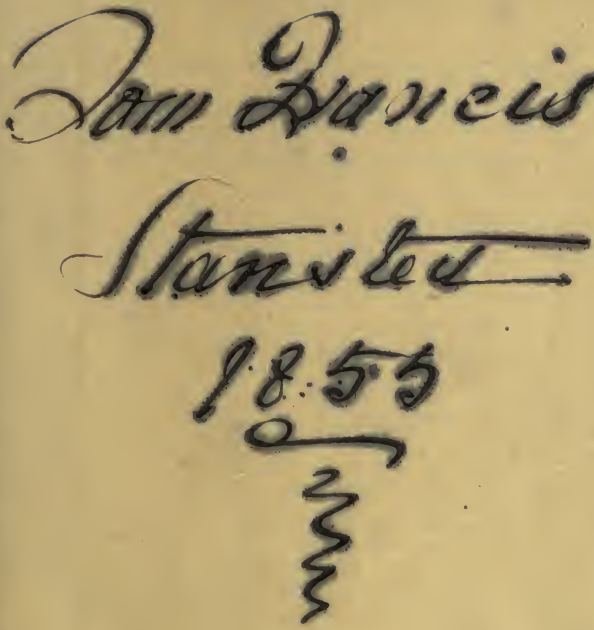
Dr GARRETT
ON
E. & N. E. WINDS

DIET AND DIGESTION

1923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ON

EAST AND NORTH-EAST WINDS,

THE NATURE, TREATMENT, AND PREVENTION

OF

THEIR SUFFOCATIVE EFFECTS.

EMBRACING ALSO THE SUBJECTS

OF

DIET AND DIGESTION,

THEIR ERRORS AND PENALTIES.

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PREFACE.

The consciousness of having fellow-sufferers in distress, softens down many of the asperities of human miseries. If one victim escapes,—expectant hope is awakened, and the means of his rescue become deeply interesting and consoling.

The Author, from a severe cold taken whilst pursuing his arduous vocations, endured the afflictions depicted in the following pages. By experiments, investigations, and observations, extending over many months, he arrived at the conclusions and remedies detailed in this book, and not only effected a permanent cure in himself, but from three years' subsequent experience, he confidently places his views and therapeutic measures in the hands of the public.

The Author much regrets that the few leisure hours at his command have prevented his bestowing as much time on this work as he could have wished. He can only tender his best apologies to the public, and solicit the kind consideration of the critical reader.

Thames Ditton,
January 1st, 1855.

ON EAST AND NORTH-EAST WINDS.

CHAPTER I.

CLIMATE AND WINDS.

1. "I DREAD those horrible Easterly Winds" is an expression which can only be properly estimated by those who are sufferers from their prevalence, or by Medical Men who feel the enormous difficulties of combating the miseries they entail.

2. Who is there that perambulates the Metropolis on a cold day in March with a stout N. Easter blowing its terrific blasts in his teeth who does not pity the poor creature he meets in every street whose distressed features and muffled mouth proclaim him the submissive sufferer from the dire œolian enemy? Watch his hasty faltering step,—his nervous glance, and the frequent stoppages he makes to draw as full a breath as his circumstances permit; observe how he elevates his shoulders, and supports his hands on his side as he stops to inhale, and accomplish a husky raking clearance of the windpipe, by

a cough, as metallic in its sound as though it passed through a brass tube. This is an endurer of no common an affliction,—with a sense of impending suffocation, and the most pitiable feebleness, his very look is that of trepidation and supplication for assistance. He tells you he is without a remedy,—without relief.

3. Well do I recollect listening to a Lecturer two or three years ago in the Metropolis during the existence of a N. E. wind, and seeing the poor fellow suck away at a pocket full of oranges to mitigate the dryness of the Larynx and vocal organs. Little did he suspect the grateful juice he was applying to his florid dry lips was but an aggravation of his malady.—The fountain of moisture was agreeable, easy of access, and caused no appreciable interruption to his arduous duties, amounting to an hour's lecture, delivered four or five times a-day. Barristers, lecturers, clergymen, and others who severely tax their wind-pipes, come under the same category. Indeed no one is more likely to suffer in this way than the medical man in the country, whose duties keep him in constant alternation between hot bed-rooms and exposure to cold drives.

THE CLIMATE

4. Of this country is so proverbial for its changeability, and the extremes we encounter, of heat, cold, long-continued drought, and prolonged rains, that we are exposed, as much as the inhabitants of any country can be, to the illnesses that arise from their influence.

Even in our little island, the comparative variations of temperature and climate would hardly be believed; and the physician directs his patient to those parts of the coast which possess advantages, as regards the climate, best adapted to his case; considering, first, from what winds a certain residence is most free; second, how far those winds to which it is exposed suit his patient's malady. This study is the more necessary, recollecting that climates are perpetually changing.

5. Cæsar says that the vine could not be cultivated in Gaul, on account of the *winter cold*. The rein-deer, now found only in the frozen zone, was then an inhabitant of the Pyrenees. The Rhine and the Danube, in the reign of Augustus, were generally frozen over for several months of winter. Indeed, large engineering undertakings have been known, more than once, to alter most remarkably the nature of the climate, and to introduce diseases which were previously unknown to the locality.

6. To Sir James Clark we are much indebted for some very able observations in reference to climate, and to the local advantages to be derived from certain sea-side and inland residences.

7. He points out that the *South Coast*, comprehending the tract between Hastings and Portland Island, is best suited for pulmonary and feeble affections; that it is protected from the N. and N. E. winds; and its advantages exist chiefly in December, January, and February.

8. The *South-West* coast of Devonshire is noted for

its mildness; for during the months of November, December, and January, the difference in temperature is, on the average, five degrees higher than that of London during the same period; whereas, on the South Coast, the difference scarcely exceeds two degrees: the former latitude being the most steady; the higher temperature being most remarkable at night. Irritable and inflammatory habits here find the best climate; it is least suitable for relaxed nervous persons, or copious secretions or discharges of any kind, but highly advantageous for *dry, irritated* conditions of the mucous membrane.

9. The West (Clifton) is more bracing and *drier;* it is less suited for pulmonary, irritable, and inflammatory disorders; and, for irritable dyspepsia. It is best for relaxed languid habits, and fluxes of the mucous membrane.

FOREIGN CLIMATE.

10. The South-West of France is similar to our own S. Westerly shores, with a mean temperature of 4^0 higher in favour of the former. The climate is soft and humid. Pau is drier and warmer in the spring, and the N. winds less trying to invalids than in this country.

11. The South-East of France is warmer and drier, but more irritating and exciting than the South-West. There is great liability to cold piercing N. W. winds (mistral), which are most injurious to inflammation or irritation of the respiratory organs; so that "the South of France" is a term which may risk the suitable se-

lection of a residence for consumptive patients; for if tubercles are already formed, the S. E. winds would be most injurious.

12. It is my duty to describe those circumstances only, connected with the atmosphere, which relate to its influence on the animal economy; and I may here observe—as it will be alluded to hereafter—that the composition of moist air embraces those four elements, carbon, hydrogen, nitrogen, and oxygen, which alone form the basis of *all animal and vegetable* compounds. (Water contains 1 measure of oxygen and 1 of hydrogen; the atmosphere 79 measures of nitrogen, 21 of oxygen, and about 1 per 2000 of carbonic acid, &c.) This startling announcement must be borne in mind, as being the fundamental knowledge on which the chemistry of animal and vegetable organization rests.

13. In the air, other matters are *held in solution;* for the *real* composition of the atmosphere has been found to be identical on the hottest or coldest days—in the clouds or in smoky cities—on the summit of the lofty Alps or the lowest swamps of Holland. But nitric acid, ammonia, sulphuretted hydrogen, ozone, effluvia, gases, vapours, fungi, &c., enter into the bulk of the air, or rather are temporarily suspended in it. The variable constitution of the atmosphere is thus substantially only altered by them.

14. Atmospheric forces, or the action of the winds must be taken into separate account, and these have more or less their especial influences on the human system.

WINDS.

15. In addition to the common attributes of great movements in the air, such as propelling ships, scattering seeds, churning gases with the waves, purifying low swamps, intermingling gases, diffusing rains, &c.; there is still one other circumstance connected with it, its great absorbtion of fluid, usually termed evaporation; and which will form part of our investigation hereafter.

16. N. E. winds prevail *most* in January, March, April, May, and June; *least* in July, September, December.

E. winds prevail most in spring.

W. winds prevail most in summer and autumn.

S. W. winds prevail most in July and August.

Winds are boisterous in December and January; next in March and November; least in August and September. The sun being farthest South in December and January, the air seeks to preserve its equilibrium. All these changes have their special influences, and put in action their temporary powers on the creation and phases of diseases. This subject might be dwelt upon to a great extent; but sufficient has been stated, ere we now proceed to examine the nature of the winds blowing from the several points of the compass.

17. North winds are generally cold, coming from Polar regions, over mountains of snow and seas of ice; they are exceedingly *drying*,—being charged with no moisture in their transit, and greedily imbibing it in our climate.

18. North East winds rarely bring rain ; they come from colder climates, and have a great capacity for imbibing vapour : therefore they *dry* the air, dispel clouds, and consequently promote rapid evaporation from the skin and mucous membranes.

19. East winds in England are generally cold, because they pass over the cold swampy plains of the North of Europe, and have no great breadth of ocean to flow over, so as to warm them before they reach our shores. They are *dry*, coming over vast continents, and very little ocean ; in consequence of which, they have absorbed very little vapour, if any, and by reaching our island dry, they readily absorb all moisture. The Harmatan winds, blowing off the West Coast of Africa, are so drying, that the planks of the decks of ships split, and the human skin becomes dry and harsh. The same happens with the Sirocco winds, which blow off the Northern Coast of Africa, passing over the desert ; they cover vessels, even 200 miles from land, with the hot dry sand.

20. South winds are usually warm, because they come over the hot sandy deserts of Africa. They bring rain ; because, heated by hot sands, they imbibe water plentifully in passing over the Mediterranean Sea and British Channel, the moisture being condensed on reaching our climate.

21. South West winds generally bring rain ; they come from the torrid zone, and condense on our Northern island.

22. West winds are usually rainy ; coming over the

Atlantic, they are laden with moisture. The least chill therefore deposits rain.

23. The facts I have already stated are to the effect, then, that the East and N. East winds are *drying* in their character; and on reaching this island, their thirst for moisture causes them to absorb it most vigorously from all bodies which can furnish them with the slightest supply. Nor is it to be supposed that because they prevail on a rainy day, that their rapid passage over a few miles of country through the rain can have moistened, more than in a very trifling manner, the components of the atmosphere;—though the general evaporation from the earth's surface on a wet day, from trees, &c., may moderate their furious demands, and mitigate the sufferings arising from their drought. But on a day free from rain, how dry the dust of the roads looks, tastes, and feels, as the gruff Boreas rushes at you like a herd of wild bulls, raking up the earth, and covering, choking, and blinding you with road-dust. The same facts are illustrated in various other ways; the laundress finds her clothes dried very quickly,—and the shoemaker profits by the number of shoes sent him to repair, parched and cracked in all directions; verifying the adage, "It is an ill wind that blows no one good."

24. Feel how dry and "fluffy" your hair is in spite of the liberally applied pomade in the morning. See the horses and cattle in the fields, how rough their coats become, and how they congregate to the leeward of all places that can afford them shelter. A double

shed was erected in a field,—one having a N. E. aspect' the other a S. W. During the existence of a N. E. wind, the animals were all observed to inhabit the shed with a S. W. aspect; but on the winds changing to S. W., they frequented both promiscuously. The leaves of plants, shrubs, and even of forest trees, look dry and withered, from the exhaustive evaporation of their foliage; in fact, all animated nature unanimously manifests its abhorrence of, and suffering from, this peculiar atmospheric force.

25. These then are all the circumstances, as far as I know, which relate to the subject of winds, as regards the matter under investigation. As we shall discuss the morbid effects of winds hereafter, it may be proper here to repeat, that Science has as yet been unable to discover any material difference in the chemical constitution of the several varieties. Some have supposed that ammonia predominated; others, that nitrogen was unusually abundant: some presumed nitric acid to be generated; but some doubt still hangs over the subject.

26. It may now be inquired in what manner Respirators benefit the invalid? I can only suggest three.

1st. That they break the force of the winds, which is, I think, not the true advantage; for an umbrella would answer this purpose.

2nd. They warm the air proceeding to be inhaled. This is doubtless, auxiliary,—though a heated stone, wrapped in a handkerchief and held to the mouth confers no immunity, and but very

little relief, on the invalid suffering from the E. and N. E. winds.

3rd. They condense the exhaled moisture of the breath,—preserve it from the absorbing winds, and return it to the respiratory organs in each respiration, which is a circumstance of very great relief and advantage in the absence of remedial and preventive means.

27. One observation may here be very properly introduced to avoid misconception. The cold Easterly winds and the dry frosty air differ in this respect, that the former has a powerful affinity for moisture, while the latter by reason of its low temperature cannot hold it in a liquid form, and therefore does not dispossess other bodies of their humidity.

CHAPTER II.

THE MUCOUS MEMBRANE, AND SKIN.

28. The mucous membrane is that moist sheet which is continuous with the skin at the several outlets of the body, lines the various open channels of the system, and all those chambers and passages which have communication with the external air.

29. Its chief duty is to secrete an inoffensive slimy fluid for the protection of the mucous membrane from mechanical and other passing causes of irritation.

30. In this Treatise my observations will chiefly be confined to *one* of the three mucous systems, *the Gastro-pulmonary*,* so called from its lining the gullet, stomach, and bowels, as well as being a direct continuation into the windpipe and lungs.

31. In order that I may be the more clearly comprehended, I must here enter a little into the minute anatomy of Mucous Membranes. I have already stated that the mucous membrane is continuous with the skin as seen at the lips; and so similar is its minute anatomy that no microscopic power can enable us to say where

* γαστηρ, the stomach; πνευμων the lung.

either terminates, or the other commences. That tiresome and unsightly blister or bleb which frequents the lips, (Herpes labialis,) and is so characteristic of cold and catarrhs, raises up equally the outer layers of the skin and mucous membrane.

32. It was left for the present century to explore, by means of the microscope, the arcana of our organization. Chemistry has advanced nobly in the cause, and *explained* the minute operations which that wonderful instrument has so miraculously revealed to us.

33. The fact is now established that our growth, repair, secretions, and indeed all the vital operations of our system are accomplished by *cells* endowed with extraordinary faculties for those and other purposes.

What is a cell? is a question I put as a Tyro, and expect to be asked in my turn. A *cell* is not visible to the unassisted sight, but under the magnifying lens the simplest cell is seen to be a hollow globule, and may be compared to a white currant deprived of its contents, though a highly magnified representation of one. It is in fact a hollow skin without an opening. We will suppose this skin to be smeared over in its *interior* with a slimy substance, and lying collapsed ready for service.

34. The duties of this cell are called into action by a peculiar endowment of animal membrane called *Endosmosis*. This property must be understood, as it is much concerned in what I shall have to point out in the following pages.

Take a glass tube open at both ends,—cover one end with fresh bladder. Have in readiness two fluids of

different densities—one being pure water—the heavier fluid being a solution of gum, salt, or sugar. Fill the tube with water, and plunge the lower covered end into a basin containing the denser liquid. The thinner fluid (water) makes the easiest and speediest passage through the membraneous structure; it thus flows from the tube into the denser fluid and leaves the tube empty. The act of entering the basin is called *endosmosis* (ενδον within ωσμος, flowing); the act of leaving the tube is called *exosmosis*—(εξ out of, ωσμος) Reverse the experiment, fill the tube with the denser fluid and the basin with water,—the water will leave the basin, enter the tube, and cause it to overflow.

35, We will now suppose an empty cell to be plunged in water; the gummy matter in its interior being of a denser quality than water, the cell fills to repletion by endosmosis, and if the process be allowed to proceed, it bursts. Reverse this, and place a full cell in a thick syrup (or fluid denser than its own contents) the fluid will leave the cell empty and shrivelled by exosmosis. Place cherries (with their stalks on, to close the hole) in brandy, the spirit is endosmosed into the cherry, which swells in consequence. Preserve them in thick syrup, they exosmose and shrivel like raisins. Hams are prepared by exosmosis; smeared with treacle or thick brine they exosmose water, &c. and are said to be "*cured.*" The cook, in boiling pease or beans acts on these principles; she throws salt into the boiling water, and causes them to be either watery or floury, full or shrunk, according to her tact in estimating the proper

quantity of salt, and thus she really sets in action endosmosis or exosmosis at her pleasure.

36. It will be expedient first to consider the *minute anatomy of the skin,* which I shall have greatly to allude to, and which much resembles in its structure the Mucous Membrane. The external layer (the epidermis, raised in blisters) is composed entirely of cells, which are round and moist in its deeper structure (formerly called rete mucosum) but flat, scaly, and dry at its superficial surface. These cells are constantly scaling off above, and are actively renewed from its under surface. Next comes the derma, or true skin,—composed of two laminæ,—the papillary or sensitive layer most superficial, below that, the corium or defensive layer, (a fibro-vascular structure) the whole being supported on areolar tissue, (which butchers blow up in veal) in which grow perspiratory glands, hair bulbs, and their pouching appendices the oil glands.

37. The Mucous Membrane has a similar structure to the skin; the former being exposed to moisture, and the latter being dry has very much to do with their apparent differences. If a portion of skin is made to occupy an internal position, it becomes mucous membrane, and when a portion of the latter becomes external, it loses its moisture and assumes the appearance of skin. The snake in shedding his skin, sheds also that continuous structure of mucous membrane (the conjunctiva) which forms the front covering of the eye. The hydra, or fresh-water polype, is a mere digestive tube; by turning it inside out, the lining mucous membrane

and external skin respectively exchange their characters and functions.

38. The external cell-coat of the mucous membrane, called the epithelium, corresponds to the external cell-coat of the skin, the epidermis. Next comes the corion, the analogue of the derma, which is composed of two laminæ; the basement membrane (alias membrana propria)—a sensitive layer, the most superficial, and like the papillary layer of the skin flooded with blood-vessels, &c. Next distant from the surface is the fibro-vascular layer lying on areolar tissue. The following table will shew their analogies.

SKIN.	MUCOUS MEMBRANE.
Epidermis,—cell structure.	Epithelium,—cell structure.
Derma { Papillary layer—sensitive. Corium—defensive.	Corion { Membrana propria. Fibro-vascular layer.
Supported on areolar tissue.	Supported on areolar tissue.

39. The same circumstance which obtains in the cell structure of the skin (the epidermis), prevails also in the epithelium; namely, that the loss of cells is perpetually taking place on the upper surface, and the balance of quantity maintained by reproduction at its deeper surface. If any intrinsic or external cause should disturb this balance, then diseased action must follow, and this is a circumstance to which we shall hereafter allude more particularly.

40. The faculty of the animal cell, as far as we have yet seen, is simply that of filling itself with fluid. Dr. Carpenter says,* "The epithelial cells being always in contact with fluids, do not dry up into scales like those

* Manual of Physiology, § 231, by W. B. Carpenter, M.D.

of the epidermis; and they differ from them also in regard to the nature of the matter which they secrete in their interior. In this respect, however, the epithelial cells of different parts are unlike one another, fully as much as any of them are unlike the cells of the epidermis: for we shall find that ALL *the secretions* of the body are the product of the elaboration of epithelial cells; and consequently there are as many varieties of endowment in these important bodies as there are varieties in the result of their action."

41. I shall now proceed to illustrate the action of epithelial cells, by showing how they discharge the duty of secreting mucus.

The mucous membrane is studded with an immense number of follicles (follicula—a little bag), which dip their blind extremities into the membrana propria, which is highly vascular. A stick poked through a layer of fine gravel, and having just pierced the clay below, would leave a hole much resembling a magnified follicle. The particles of fine gravel on the surface, and those which are dusted over the interior of the hole, would well illustrate the epithelial cells. The close proximity of these cells to the blood-vessels in the membrana propria, enables them to draw from the blood, by endosmosis, those very elements which are necessary to form healthy mucus. The cell, thus filled, flies to the orifice of the bag, bursts, and delivers its contents—its cargo of mucus, upon the free open surface. Fresh cells are generated at the farther extremity of the follicle (at the germinal spots), which repeat the duties of their

predecessors, fill themselves to repletion, fly to the orifice, where they are shattered, and their disintegrated lifeless carcases are seen by the microscope carried onwards in the viscid stream.

42. Knowing what we do of the excitability of secreting organs, we can readily conceive that this secretion is at the mercy of many influences, and may be excessive, scanty, or suppressed, viscid, puriform, or watery; or may be charged with numerous unhealthy products. All the secretions of the body are thus carried on. Not a tear is shed, but large families of cells are engaged in its secretion, whose existence is sacrificed even before the tear is visible.

43. But these cells have not only the power of increasing the structure of their own walls by interstitial growth, and of endosmosing certain fluids into their own bodies, but they have the *faculty of selection*, and whether it be the bile-cell, the milk-cell, the fat-cell, mucous-cell, or any other, that cell so employed withdraws from the blood those *very elements only* which are necessary to form its own appointed material! In the healthy state these duties are performed with such undeviating integrity and mathematical accuracy, that not only does it appropriate for its elaborating uses from the blood all the elements required, in unerring proportions, but no man can tell how many generations of cells may have been created, employed, and slain in a single second of time!

44. We are astonished when we contemplate the fact that a certain spring at Leamington contains invariably

about a grain of iodine in every gallon of water which it pours forth; that other springs, some saline, others chalybeate, are charged with numbers of ingredients, possibly not differing throughout the year more than the slightest fraction in any of their numerous ingredients. If we looked down in one of those wells and saw a perpetual succession of bottles coming up to its mouth laden with mineral water, splitting to pieces on the ground and pouring their contents on the land, what wonder would fill our minds at such a marvellous organization! but we find that this well, its chemical waters and bottles, are all typical of a single mucous follicle, and that there are myriads of them in a single square inch of membrane! How beautifully appropriate is the language of Galen: "In explaining these things, I consider myself as composing a hymn to the Author of our bodily frame; and in this I think there is more true piety than in offering to Him hecatombs of oxen, and burnt-offerings of the most costly perfumes."

45. These operations, again, be it remembered, take place in every act of secretion, and in every organ of the animal economy. The same occur when the endosmosed contents of the cells are intended for growth, deposit, or repair; whether for skin, flesh, fat, nails or bone, or for the removal of the refuse matter of the system. If these mucous cells are exposed to much evaporation, and their envelopes become dry, as in the skin, and often seen in the cracking lips, then endosmosis is either much interrupted or defeated. If unhealthy matters are presented to the cells by the blood,

as lithic and other acids, to an injurious amount, or miasmatic or other poisonous matters, then they become embarrassed, refuse to act, and fearfully jeopardize the system. The poison of scarlatina acts thus on the kidneys, hence the frequent dropsy which happens in that disease.

46. Again, the epithelial cells, offended by the cachectic state of the system, and the impurities presented to them in the blood, occasionally manifest their sense of the injuries done them, and will on their part collect substances of a most impure character, and present the poisonous products to innocent organs and tissues. Urinary calculi, gout-stones, tubercles, &c. are common illustrations. The muciperous (mucus-making) cells of the wind-pipe and air passages, are far more obnoxious to extraneous influences than almost any others; they are never free from duty, or at rest. They are especially exposed to the action of the atmosphere, and all irritating matters floating therein, and are engaged in the perpetual secretion of mucus to moisten the air-tubes.

CHAPTER III.

DIGESTION.

47. Digestion is divided by authors into several stages, the first of which (mastication) commences in the mouth. The peculiarities of the molar teeth and the free action of the lower jaw, distinguish man from carnivora or herbivora. The teeth not only tear the food asunder and break up its texture, but mix up with it a suitable quantity of saliva and atmospheric air. The action of mastication is one of more importance than is usually supposed, but is well known to those who have unhappily lost their teeth, and others who bolt their food.* The mucus of the mouth is in a constant state of exudation, and is slightly alcaline. Its chief property appears to be the lubrication of the mouth and fauces.

48. The saliva has duties of a far more important character. It is rapidly secreted by a person in health during a repast: "if the saliva predominates, the fluids

* Jackson the pugilist used to say that he knew an infallible plan for making any child crooked: viz. let it bolt its victuals and stand on one leg.—Mayo's "Philosophy of Living."

"Bolting food in children is generally owing either to a morbidly

of the mouth are acid: if mucus predominates, they have an alkaline reaction." (Carpenter.) Saliva acts most usefully on farinaceous substances whilst in the mouth by converting them into dextrine and sugar,—a fact worth being remembered by nurses, who dose their infants with too much of that article.*

49. The *senses* greatly control and aid the salivary secretion, (the " mouth-watering " of our youth); and as these senses are presided over by the mind, it follows that mental attention should be directed to the enjoyment of the meal. The Indians detect a thief by causing all the suspected persons to chew a portion of rice and spit it on a leaf. The *anxiety* of the culprit arrests the flow of saliva, and the unmoistened rice detects the delinquent. Deprived as infants are of the power of exciting the salivary secretion by the auxiliary senses, Providence has compensated this privation by a most beautiful, yet simple contrivance. During the action of sucking, the buccinator and other muscles, together with the tongue press, by a series of undulating contractions, on the several salivary glands which surround the mouth, and squeeze, during every act of sucking, such a quantity of saliva from these glands, as may be necessary for this—the first step in the process of nutrition. Infants fed with a spoon may, and often do,

ravenous appetite, through unhealthy secretion of the stomach, to *tender gums*, or *carious teeth*,—all of which may easily be relieved and the habit conquered."—" Surgeon's Vade Mecum," by Dr. Druitt.

* Spallanzani found that aliment enclosed in perforated balls in the stomach, was more easily digested when previously mixed with saliva.

starve from actual innutrition; but if they be fed by sucking the same food from a proper vessel, they immediately thrive and regain their health.

50. *Ptyaline*, the active principle of saliva, has its solubility destroyed by alcohol, (pure spirits,) and is thus robbed of a property which renders it so valuable an agent in the business of digestion, and, as we shall presently see, the practice of dram-drinking before or during meals, is one of the most injurious character.

51. The *stomach* is an organ as remarkable for the mechanism of its construction, as it is for its patient endurance of the immensely laborious duties which are imposed upon it. This thin membranous bag is numerously supplied with nerves, veins, arteries, &c., and is lined with mucous membrane, copiously studded with mucous follicles. It may be said to perform duties almost entitled to be called instinctive, if not intelligent. It advises you of its plenitude, emptiness, or dryness. It announces the presence of any offensive or indigestible matter: it has the power of revolving its contents, of secreting a powerful composition for dissolving them, as well as a viscid fluid for the protection of its own surface. It absorbs and carries away to the liver certain soluble matters by the endosmosis (sucking up power) of its veins; and so cognizant is it of the necessities of the system, that the stomach only eliminates so much gastric juice as is sufficient to act on that exact amount of food, that the body is at that particular time, in need of.*

* Blondlot says (Traité Analytique de la Digestion) "Galvanism

52. The stomach and the brain exchange sympathies. A blow on the head readily produces vomiting; and indigestion gives rise to much pain and disturbance in the brain. The eighth pair of nerves (the Pneumogastric) supply in their passage from the brain to the stomach certain parts in the throat, the heart, lungs, &c., and are the nerves which convey to the sensorium the impression of the condition of the stomach, and inform the brain of the state of hunger, thirst, and satiety. The sensation of *thirst* is experienced in the fauces, whilst the stomach is more especially the seat of privation. A fluid slightly damping the mucous membrane of the throat, only temporarily relieves thirst, as is demonstrated by the school-boy trick of putting a cold stone in the mouth, which by exciting the flow of saliva moistens the interior surface. Thirst is not actually relieved or removed, till fluid is carried into the circulation, either by the absorbing vessels of the stomach, or by injection into the veins. (See § 62.) Here then is seen a telegraphic line of communication between the stomach and interior of the throat. We now see how derangement of the stomach produces many fearful diseases, as crowing inspiration: why dyspepsia in infants causes "stomach coughs:" why new bread often

even has not power to create or augment the flow of gastric juice, or to increase the muscular movements of the stomach, unless there is food in it to be acted on."

Dr. Combe says, "The quantity of gastric fluid which the stomach is capable of secreting, always bears a direct relation to the amount of sustenance required by the system at the time."—Physiology of Digestion, p. 47.

causes a choking sensation. The sympathies also between the respiratory organs and stomach are observed in the sickness caused by inhaling fœtid odours, and the hurried breathing which accompanies the sense of nausea. This alliance also explains why the larynx should be dry and irritable when the stomach is so. We shall presently see that the continuity of the sheet of mucous membrane is much concerned in those disordered states of the interior of the larynx which accompany disturbed conditions of the stomach.

53. The sensation of *hunger* can now be better comprehended. Hunger is not relieved by a small quantity of food only, however nutritious; but *bulk* is required to some extent, and for the purpose of exciting the elaboration of a satisfactory quantity of gastric juice, experience has shown the advantage of mixing with a scanty meal, even *innutritious substances*, in order to give it bulk and solidity. For if this be not done, the gastric juice is not poured forth in proper quantity, and the result is, that neither the sense of hunger is relieved, nor are the wants of the system satisfied. The Kamschatdales are in the habit of mixing earth or saw-dust with the train-oil, on which alone they are frequently reduced to live. The Veddahs, or wild hunters of Ceylon, on the same principle mingle the pounded fibre of soft and decayed wood with the honey on which they feed, when meat is not to be had.

54. The *gastric juice* is a very vague term, but it is one which Physiologists have applied to a peculiar secretion of the arteries of the stomach, and which takes

place according to the observations of Dr. Beaumont, in the case of Alexis St. Martin, *only when food is in the stomach.**

55. Its active principle is called *Pepsine*, a substance which appears not to be a solvent in itself, and only seems to act on food after the manner of heat, by softening its structure. It is supposed to act like Ptyaline, as a ferment ;† and the atmospheric air introduced into the food by chewing, is believed to contribute to that fermentation. Herein may be some advantage in frothing our beverages—even water at our meals.

56. But if pepsine is *acidulated*, it becomes a powerful solvent. Healthy gastric juice is secreted with an acid in its composition of precisely that strength or proportion which gives it the most solvent power; and it is found that its digestive power is equally impeded, whether the acid be *deficient* or *in excess*. There are great disputes as to the nature of this acid; and the difficulty of procuring pure gastric juice (which is secreted only when food is present) has been a great impediment to chemists in determining its nature. Of all acids the hydro-chloric and lactic are proved to have the most

* Alexis St. Martin, a young Canadian, eighteen years of age received a musket wound on June 6, 1822, which left an opening into his stomach capable of admitting the whole middle finger, through which all that was going on in his stomach could be actually seen and watched.—Experiments and observations on Gastric Juice and Digestion by Dr. W. Beaumont.

† Liebig says that saliva ferments farinaceous food, and gastric juice ferments protein compounds (flesh); the first he calls fermentation, the latter putrefaction.

solvent powers when mixed with pepsine; and some contend that these two acids replace each other.*

Dr. R. D. Thomson speaks with more confidence: † he says, "The filtered liquid of the stomach contains no hydro-chloric acid, but an acid which is either *lactic acid*, or corresponds very closely with it." I may remark that the lactic is an acid which is abundantly secreted by the skin as well as in the system.

57. Dr. Beaumont and others have shown that increased vascularity of the mucous membrane of the stomach causes an *increased* secretion of *acid*; whereas a long-continued abuse or over-taxation of the digestive functions, causes an apathy of the secreting powers, diminished vascularity, and a *deficient elaboration of acid*.

Let us examine two such cases. First, that of a young man suffering from irritation of the mucous membrane; at dinner he takes a little soup and a glass of wine; his face becomes flushed, his eyes glassy, his lips red, tongue florid—lake colour, with headache and giddiness, and rumbling uneasiness over the abdomen. If he takes more wine, beer, or other acid, his distress is

* At an elevated temperature Hydro-chloric acid is obtained, but this is equally the effect of heating together chloride of sodium (table-salt usually found in the stomach) and lactic acid.

Lactic acid				Lactic acid	into Lactate of soda.
Table salt	Chlorine, Sodium	reunite	thus	Oxygen, Sodium	
Water	Oxygen, Hydrogen			Chlorine, Hydrogen	into Hydro-chloric acid.

† On the food of animals, &c. p. 20. See also Todd and Bowman's Physiology.

increased, his breathing becomes short, hot, and suffocative, and his taste very inaccurate and dull. Litmus paper placed in the mouth shows the greatest acidity; and, in proof of the cause being an excessive secretion of acid in the stomach, a well proportioned dose of an alcali corrects the acid, and immediately quells all those symptoms, which may be renewed by again taking a small quantity of vegetable acid. Raking, excitement of society, rich, irritating, and improper food,* and in fact anything which excites the acidulous action of the mucous membrane, will lead to this distressing yet most easily curable malady. Females, from various causes, are especially liable to this form of dyspepsia. When a child is teething, or has a cold, the same acidification takes place, and it rejects its milk curdled, and containing free lactic acid in great excess; an alcali is known to be the remedy for its cure.

58. We have seen that a florid tongue denotes arterial vascularity and acid secretiveness of the stomach. The sodden buff-leather tongue of the gourmand denotes a totally opposite condition. The stomach has lost its vascularity, its nervous energies, its secreting powers (particularly as regards the elimination of acid), and is now a mere distended bag. He takes brandy-bitters before dinner, to excite the vascularity of the stomach. The secretion of acidulated pepsine fails, digestion stands still, and he endeavours to compensate the absence of acid furnished by the stomach by taking them freely in

* Dr. Bence Jones says "Common salt promotes the secretion of acid by its irritation of the Mucous Membrane of the stomach."

his diet. His turtle-soup is washed down with acid punch; he takes lemon-juice with his white-bait, cucumber-salad with his salmon, acid jelly with his venison, lemon, mint-sauce, apple-sauce, pickles, salads, &c., in abundance, and selects those wines which are characterized by their acidity. The secretion of acid by the mucous membrane of the stomach is further provoked by curries, spirits, olives, anchovy-toasts, and the hot spices.

59. We now come to the following conclusions :— 1. That an acid is necessary for the digestive process. 2. That a quantity of acid, much below or exceeding the healthy standard, impedes or destroys the powers of digestion. 3. That irritation of the gastric mucous membrane excites an abnormal and injurious excess in one case, and a most scanty and strained contribution of acid in the other. That these respective opposite states are demonstrated on the tongue, and must exert a morbid influence on the whole sheet of mucous membrane. We may properly entitle one "the irritable or acid state," and the other the "leathery or acidless state." The nervous connection between the stomach and the larynx, shows how the local nerves of the latter may be the nestlings of stomach derangement.

60. A few more remarks in reference to the gastric juice.* *Temperature* affects it much. Dr. Beaumont

* Artificial digestive fluid. Take a bit of Mucous Membrane of the stomach of a pig, macerate it in distilled water for twelve hours at 98° or 100°. Add diluted Hydrochloric Acid till the precipitate is redissolved. This is an acidulated solution of Pepsine in Water. (Todd and Bowman's Physiology).

discovered that, " at a temperature of 115^0 to 120^0 F., the solvent power of gastric juice was destroyed, not to be regained by cooling; though the temperature mentioned had not, as far as science could detect, affected its other chemical qualities; that a temperature much below 100^0 had a similar effect. Pepsine is perfectly insoluble in warm water. These are facts which may interest persons who drink their tea very hot, and those who take ices whilst digestion is going on.

61. I previously remarked on the salutary and influential action of the mind on the flow of the saliva; the same observations apply, but with much more force and importance, to the process of digestion. That digestion should proceed properly, and in a manner beneficial and comfortable to the individual, it is necessary that the nervous influence should be devoted, as much as possible, to that process. That the appetite should, by its exalted gratification, direct to the several secretions the fullest share of mental assistance; on the other hand, the abstraction of nervous energy by reading or profound thought, impedes digestion, and in men of business occasionally entirely interrupts it. Reading a newspaper at breakfast impedes weak digestion. Commercial or literary men, and others who actively employ their mental faculties on a full breakfast, suddenly perhaps, divert the nervous action from the stomach, digestion flags and stops, the aliment taken causes gastric irritation; giddiness, fainting, and numbness ensue, and the sufferer believes himself to have been threatened with a fit. He goes through the operations of cupping,

purging, and starvation very needlessly; and is left weak and sickly, more from the effects of the maltreatment than of the malady. The expenditure or employment of nervous influence during digestion, is exceedingly improper, and may entail much constitutional distress and functional disturbance.* Dr. Caldwell says, "Dyspepsia commences in the brain as often as it does in the stomach." The merry conversation which leads to hearty laughter, like moderate exercise, churns up the contents of the stomach, and tends to rub up some nervous energy. Hence gourmands rarely like to dine alone, and why my Lord Mayor's fool was retained as a *digester*. So important to my subject is the consideration of these secretions, and their uses, that I have dwelt upon them at some length.

62. We will now suppose that a meal has been taken of flesh meat, boiled greens, and rice (farina), with a moderate quantity of water. The vegetable matter first finds its way through the lower (pyloric) aperture of the stomach into the first bowel (the duodenum). Fatty and farinaceous matters follow. The animal substances remain in the stomach, to be acted upon by the gastric juice, and then are called *chyme*. The arteries of the stomach having secreted gastric juice, &c., the veins are in a better condition for sucking in fluids. They actively endosmose water and such soluble matters as are of less density than the blood itself (of lower sp. gravity than 1055), also alcohol, gum, salts, sugar,

* Delicate children should not make too hearty a breakfast, nor study after dinner.

and water, all of which are conveyed direct to the liver for assimilation.

63. The lower (pyloric) orifice is surrounded by a ring of muscular fibres, called a sphincter, which stops the passage of offensive matter into the duodenum; and if the intrusive material becomes importunate and repeats its application for passage through the portal, a retrovertent action rejects it by vomiting. Occasionally, in a more torpid state, the pylorus permits coins, buttons, &c. to steal a march, and pass into the bowels.

64. The vegetable matter is supposed to have arrived in the duodenum and is moving forward, its soluble portion being absorbed as it slowly progresses along the intestinal tube. Its lignine (woody fibre) completing the whole route of the bowels as seen in herbivora.

65. To return to the duodenum; fat and farina (all kinds of flour or corn-seeds) are here acted on by the bile and pancreatic juicé. Fatty and oily matters are saponified (converted into soap) by the combined action of these two fluids. What amount of credit is due to either of them has not yet been determined. Pancreatic juice consists of the alcaline salts of potassa largely diluted with water, which confers solubility on various substances which arrive here. Bile consists chiefly of choleic acid and soda, (an alcaline choleate of soda) bili-verdine, &c. That the pancreatic fluid is much concerned in the process of saponification, is evident from the fact that when oil-globules, or fatty matter continue to appear in the fœces, the pancreas is invariably found to be diseased.

66. Both fluids assist in neutralizing the acidity given to the food in the stomach, and by making them alcaline, they again become soluble. The pancreatic fluid acts on all farinacious food, by converting it first into a soluble gum (dextrine) and afterwards into sugar. The soap and sugar are picked up by the lacteals for important purposes hereafter. The chyme (acidulated animal food) now arrives, and is divided by the action described into two portions, *chyle* and refuse; the former enters the lacteals, and the supply of nutriment is at length completed.

67. The functions of the bile may thus be summed up:—1. It assists in alcalizing the chyme. 2. It saponifies fat. 3. It aids the lungs in removing carbon and hydrogen from the system.* 4. It separates chyle from refuse. 5. It is an aperient,† antiseptic and emetic, and stimulates the secretion of mucus. The quantity of bile secreted in 24 hours is variously estimated at 17 to 24 ounces; a very small portion passes off in defæcation, (a 34th part of the whole); the rest is reabsorbed, and having undergone a second assimilation is *burnt* in the system in support of animal warmth and respiration; but if bile gets into the system not secondarily assimilated, then the *shivering* emaciation and constipation of jaundice proclaim its poisonous in-

* In Phthisis, the liver becomes fatty from over supply of Carbon, owing to the incompetency of the lungs. In hot climates, it is congested and indolent from the skin performing extra duties.

† Hence the use of Ox Gall suggested as an aperient in liver complaints.

fluence. Schwann tied the bile-duct of a dog and drew off the bile by an external orifice; the dog died of emaciation. Another he permitted to lick the bile trickling from the wound; he lived and flourished. The excretion of bile is supposed to be excited by food in the bowels, for if a man dies of starvation, the gall-bladder is found invariably to be full.

The following substances being insoluble in the stomach, proceed into the duodenum, to be acted upon by the pancreatic fluid and bile.

1. Starch, converted into sugar.
2. Oil and fat ,, ,, soap.
3. Resin, salts, lignine.
4. Protein Compounds { Albumen, Fibrine, Caseine } converted into a peculiar form of albumen.
5. Gelatine.

69. The absorption of these materials from the duodenum is performed by small finger-like prolongations of the mucous membrane called *villi* (about thirty-six to the square line), the exact antitheses of the follicles. Let a small quill, surrounded by a few bloodvessels, and covered with leather, represent a lacteal tube (so called from containing milky-looking chyle) and mucous membrane. Sprinkle this with the finest gravel representing epithelial cells, and you have a complete illustration of a villus. The cells elect and endosmose the chyle into their interior; this they present to the villus where it is endosmosed into the lacteal, which has no open mouth or other communication with the contents of the bowel.

The cells, having performed this duty, are sacrificed as in the follicle. Professor Goodsir says that the disintegrated cells are seen in great abundance during active digestion.

70. This proceeding is termed by Dr. Prout *primary assimilation;* and were it not for another process taking place termed *secondary assimilation,* sugar taken as food would create perpetual diabetes, and the white of an egg would engender that fearful disease, albuminuria. (Bright's disease). Sugar and albumen injected into the systemic circulation are readily traceable in the urine.*

71. Of the shape of the stomach, little need be said, except that in the infant it is scarcely more than a bent tube, whereas in advanced life it becomes pouched and distended. The former shape makes vomiting a very easy affair—the latter a very painful one. An adult has an advantage, not of much value,—that he can eat, drink, swallow, and retain his food in the stomach if turned upside down—his head on the ground and his feet in the air.

72. That a fermentive process takes place in the digestive organs, seems to be corroborated by the presence of those gases which distend the intestinal canal. If that tube was collapsed, the secretions (pancreatic, bilious, and mucous) would be blocked up—no peristaltic action could forward the contents; a stoppage (perpetual constipation) would ensue; a slight concussion would be unendurable and destructive under several

* Carpenter's Physiology, § 493.

conditions: the large vessels would be compressed by the presence of food, and tight stays could no longer be worn, as no abdominal action could take place in aid of respiration. Combe says: * "Air injected in large quantities has been successfully employed in overcoming obstinate constipation." The bowels, five times the length of the body, (Bell,) secrete pepsine and possess absorbents in a gradually diminishing number throughout the Intestines.† Lavements of nutritious fluids are therefore of more value than is usually attributed to them.

73. It may be worth while remembering that when bark and mineral acids are administered, the tannin of the former precipitates gelatine, and the mineral acids render albumen insoluble. As these two animal substances are secreted by mucous membranes, occasional intervals of repose and purgation should be alternated with the administration of the medicine. The absorption of chyle is therefore arrested by this albuminous plaster, which in a congealed state forms the nidus of worms.

The acid of the stomach renders insoluble all animal substances. If there is little or no bile in the Duodenum to assist in alcalizing it, then the whole acidulated mass is forwarded through the bowels, producing the irritation peculiar to acids. Under such circumstances alcalies should be cautiously administered after a meal to compensate its loss; for the absorption of nutriment is also thus much interfered with.

* Combe on Digestion, p. 184-5.

† Dr. R. D. Thomson says (op. cit. p. 36) "The colon in a natural state contains water,"—a circumstance which explains the action of certain medicines.

CHAPTER IV.

RESPIRATION.

74. Respiration is that process by which carbonic acid and water are discharged from the circulation of the blood, having performed certain important duties in the animal economy, and at length become offensive and oppressive.

75. A large blood-vessel (the aorta) arising from the left side of the heart, diffuses arterial blood over the whole body. This fluid is not only laden with fresh alimentary matters imported into the system in food, but it contains oxygen in a liquid and solid form, and all the elements required for every purpose of formation, growth, secretion and repair. It contains iron in a high state of oxidization (the peroxide, 2 parts of iron, and 3 of oxygen) for not only has iron a great affinity for oxygen, as is seen in its readily rusting in the open air, but animal organization confers on that and other substances a power of combination with oxygen, which is not possessed by them under ordinary circumstances.

76. The arteries ramify over every part of the body, and end in microscopically minute tubes, (capillaries, from capilla, a hair) which terminate the arterial stream; the return current is taken up by a continuation of

those tubules now called capillary veins, which uniting and reuniting into large trunks, convey the blood to the right side of the heart, and this completes the *systemic* circulation. From thence the two pulmonary arteries carry the blood into the lungs for purification ; whence it is returned to the left side of the heart for re-distribution ; this is denominated the *pulmonary* circulation.

77. The structure of the respiratory organs is easily comprehensible. The gristly windpipe bifurcates into two smaller ones (henceforth called bronchi, or bronchial tubes) shortly after diving into the chest. By repeated arborescent subdivisions, the bronchi are distributed over every part of the lungs. Each cartilaginous bronchial tube is accompanied by an artery, two veins, nerves, &c. and terminates in a bulbous expansion termed a pulmonary cell ;* which, microscopically small in itself, is surrounded by the finest net-work of blood-vessels which penetrate its membranous structure, and by exosmosis blow off carbonic acid and water. The blood now endosmoses oxygen, and having thus discharged its noxious ingredients, and possessed itself of a new supply of oxygen, is said to be oxidized or arterialized.

78. The minute bronchial tubes are believed to possess muscular fibres, and this supposition is confirmed by the fact, that in spasmodic asthma, the extreme bronchi

* Pulmonary cells have no Epithelium, but have the other layers of Mucous Membrane.

Lieberkühn estimates the extent of the Membrane which form the minute vesicular cells of the lungs at 1400 square feet.

are spasmodically contracted, and those remedies only are efficacious which are known to relieve spasm.

79. The patient is by these means enabled to cough up irritating mucus, by a power which is too easily exhausted; for the sensibility of the bronchial nerves is speedily diminished, as we see in the coughs and bronchial affections of old persons. In these cases the pulmonary cells and smaller tubes become filled with viscid mucus; the bronchial nerves now deficient in sensibility have no longer sufficient energy to support tussive action, and aggravated difficulty of breathing ensues. The cough is incessant, and being confined to the larger bronchi, is fruitless in its endeavours to get up the sputa. Now it must be clear, that as opium can only further depress the excito-motory influence of the bronchial nerves and lessen muscular action as well as inspissate the viscid secretion, opiates must be injurious. This pathological state teaches us that if we strengthen the muscular fibres of the bronchial tubes, invigorate the sensibility and power of their nerves, correct the viscidity and any acidity of the morbid secretion, we accomplish all we desire. It should be borne in mind in such cases, that *if we stop the cough, we stop the pump.* The sesqui-carb. of ammonia taken internally, and brandy applied externally,* together with appropriate diet, will act as panaceæ.

80. The larynx is protected at its summit by an over-

* To the chest and face, for the fifth pair of nerves are largely connected with the function of respiration, as witnessed in sponging and fanning the face of a fainting person.

hanging flap (the epiglottis) from intrusive matter. In something less than an inch below, a considerable expansion of the tube is called the pelvis, or vocal chamber, situated within the projecting cartilaginous box (the pomum adami) so prominent in men. A sudden contraction of the floor of the chamber forms a chink or fissure called the rima-glottidis. The whole is lined with mucous membrane, an extension from that of the mouth and fauces. The mucous membrane of the larynx is the seat of the most exalted sensibility; every one knows the convulsive effect of a venturesome crumb, or the inhalation of ammonia, or chlorine, any of which set powerfully in action the expulsive efforts of the muscles situated in the base of the larynx. The great pneumo-gastric (lung and stomach) nerves send off on either side a superior laryngeal nerve conferring the faculty of sensation, and an inferior or recurrent laryngeal nerve bestowing motive power. The one announces the presence of offensive matter, and the other causes its expulsion.

A most important alliance is therefore established between the stomach and the larynx, which leaves us at no loss to account for the translation of morbid action from the stomach to the larynx (as in the crowing inspiration of infants); for the suffocative sensations produced by new bread and other indigestible articles; for vomiting, arising from inhaling fetid vapours and gases; and for the metastasis of diseased actions from the mucous membrane of the stomach to that of the larynx.

82. The respiratory actions which take place in the human body are not only interesting in themselves, but most important in reference to the subject under consideration.

83. If oxygen and hydrogen gases are placed together in a glass vessel, they *mingle* only, remain still gaseous, and do not chemically unite to form water at the ordinary temperature of the atmosphere; but if hydrogen gas be highly heated or deflagrated in the presence of oxygen, then these elements combine with an explosion; an immense amount of heat is generated, and the product is pure water. The same facts apply (with change of products) to carbon, whose combustion results in carbonic acid.

These combinations take place in one fixed proportion only, from which they never differ.

1 part of oxygen (by measure) and 1 of hydrogen form water.

2 parts of oxygen (by measure) and 1 of carbon form carbonic acid.

84. The vital organization dispenses with the obligations of a preliminary high degree of heat (§ 75), and permits them to combine at the temperature of the interior of the body. But the combination causes the production of heat, and a perfect but slow combustive process takes place.

These two materials, therefore, hydrogen and carbon, being actually burnt in the circulation, warm the body; and all such food as contains them to a considerable extent, is very properly called by Liebig the fuel of the system.

85. Through the highly-attenuated walls of the capillaries, these changes take place; by these terminal vessels also the true business part of the circulation is transacted; to them are due the various secretions, as well as the growth and repair of all the organs and tissues in the body.

86. The arterial blood surrenders its oxygen to the purposes of supporting combustion, and the new products, carbonic acid and water, are conveyed by the veins to the lungs for purification. The iron has parted with its peroxide, and, from combining with carbonic acid, is now become a proto-carbonate of iron.

87. It may be interesting to state, that an ordinary-sized person inhales on each occasion from 15 to 16 cubic inches of atmospheric air.* That the air can only hold in solution 10 per cent of carbonic acid. That as that proportion prevents the further exhalation of carbonic acid gas and the inspiration of fresh oxygen, suffocation must ensue (Lavoisier and Seguin). Brewers' vats, wells, and the Grotto del Cano in Spain, are instances of excess of carbonic acid gas, more than can be held in solution in the atmosphere.

88. The purposes then of taking hydrogen and car-

* The constituents of the air are easily investigated.

Carbonic acid is abstracted by caustic Potash which absorbs more than 100 times its volume of carbonic acid; therefore the loss of a slow current of dry air shews the amount of carbonic acid,—the weight of air having previously been ascertained.

Oxygen is absorbed by red hot copper. Dry air passed over red hot copper filings in a tube loses all its oxygen.

Nitrogen is known to be the residue. (Dumas.)

bon in our diet, are chiefly that they may furnish a supply for the purposes of combustion; and the objects to be gained are the equable generation of animal heat throughout the system; and secondly, a supply of water for purposes relating to osmosis and respiration.

89. Leibig has, with his usual felicity, compared the body to a furnace, and the lungs to its fire-place. Bearing in mind the fact that carbon can only combine with double its measure of oxygen, to form carbonic acid—neither more nor less;—and that hydrogen can only combine with its equal measure of oxygen to form water; it follows that the quantity of carbon and hydrogen which can be consumed must depend on the quantity of oxygen inhaled. Combustion is therefore accelerated or impeded, according to the quantity of oxygen admitted into the system.

90. The reason now becomes manifest why broad-chested persons demand most respiratory food; why the butcher selects a narrow-chested ox for fattening; and why the dairyman chooses a narrow-chested milch-cow.

This may have much to do with the reason why narrow and pigeon-chested people are often phthisical. The chest-bound lungs are obliged to respire not only more frequently but more laboriously. The lower lobes of the lungs expand the more freely, owing to the space afforded by the expansion of the walls of the abdominal cavity; whilst the upper lobes, comparatively inactive from their imprisonment, offer a genial and

undisturbed residence for the tubercular deposits of phthisis. Liebig believes that "Phthisis is the result of an excess of oxygen in the blood, which consumes its material and texture." That oxygen exercises a powerful influence on phthisis is undoubted, and seems also probable from the value of remedies abounding in hydrogen and carbon.

91. The materials necessary for respiration are nutritious food and oxygen. Lavoisier computed the annual consumption of oxygen at 746 pounds; Menzies calculated it at 837 pounds. Lavoisier and Seguin state that $32\frac{1}{2}$ ounces of oxygen are daily consumed by the skin and lungs.

92. Oxygen is taken up by the blood corpuscles in a fluid and solid state,—indeed in the lowest state of combination. The fluid part of the chyle which is endosmosed into the blood corpuscles contains much iron; both these stores deliver their oxygen in the capillaries, for the purposes of combustion; and the amount of heat generated by the union of carbon and hydrogen with oxygen, is found by direct experiment to be exactly of the same degree, as though hydrogen and carbon were burnt in a suitable apparatus, and a certain quantity of water was heated.

93. The quantity of oxygen gas inspired exceeds the bulk of carbonic acid gas exhaled. As the only other combustibles found in the body are sulphur, phosphorus, and hydrogen, and as the two former are consumed very sparingly, it would be presumed a priori that the excess was demanded for combination with the hydro-

gen—and such is the fact. Hybernating animals, who exist on their stock of fat, exhale in carbonic acid and secrete in fluid exactly their loss of fat (§ 100).

94. "Blood, when agitated with air, takes up more than one-tenth of its own volume of oxygen; and this gas may be very nearly entirely expelled by agitation with carbonic acid. When blood saturated with carbonic acid is agitated with air, carbonic acid is displaced, and in its stead oxygen is taken up, which, in like manner, may be again expelled by carbonic acid." *

The excess of oxygen taken into the arterial blood does not invalidate the law, that oxygen and carbonic acid mutually displace each other, and that the inhaled oxygen must bear relation to the quantity of carbonic acid expired; for the latter contains one measure of carbon only in three of its volume.

95. The bulk of inspired and exhaled gases being presumed to be constant, the receipt and expenditure of gases can only be increased by more *frequent* respirations, and the chief causes of their frequency are fever, radiation of heat (external cold), vaporization (perspiration), and *preternatural dryness of climate.* If 15 to 20 respirations per minute exhale a certain quantity of carbonic acid gas and moisture, 30 to 40 respirations per minute will suggest the multiple, and the increased expenditure of the resources of the system. A high state of fever is truly said to be *consuming*, and the frequent respirations of incipient phthisis too fearfully illustrate rapid emaciation.

* Liebig's Letters on Chemistry, p. 332.

96. The *temperature* of the blood is the same (98^0) in all climates, and this degree of warmth is maintained in all vicisitudes of seasons and regions of the globe; whether, as at Palermo, the surrounding temperature is nearly equal to the body, or in the polar regions, where the temperature is from 70 to 90 degrees lower than that of the human system. The inhabitants of the arctic circle and natives of the south both enjoy the same internal warmth!

97. A quicker combustion and greater expenditure of fuel are necessary, when the circumambient air is much below the temperature of the body. Therefore a supply must be kept up by such aliment (and that to a liberal extent) as is rich in carbon and hydrogen.

98. Fat and oils contain from 77 to 80 per cent of carbon, and about 11 per cent of hydrogen; circumstances which point them out as a peculiarly eligible diet for those exposed to the extreme degrees of cold. What chemistry suggests, *nature* has anticipated and realized. The Samoyedes fish and hunt nearly naked, and "consume with ease 10 or 12 pounds of fat and a pound of tallow candles into the bargain."—(Liebig's Letters.) The Esquimaux and Greenlanders eat 20 or 30 pounds of blubber at a meal. In whatever manner our bodies are cooled, an increased quantity of fuel is consumed, and an additional supply of respiratory food is required to sustain the laws of animal heat.

99. Exposure to the air in an open carriage, or on the deck of a ship, create an appetite, by increasing vaporization and the radiation of heat. The tempera-

ture of the body is lessened, and the necessity for food is increased. Copious draughts of cold water, drank perhaps at a temperature of 65^0 and vaporised at $98\frac{1}{2}$, act in a similar manner.

100. Clothing is a preservative of temperature and an economizer of nourishment; and it might fairly be a question with the benevolent as to whether coals, fat, or clothing would in the best and cheapest manner *maintain* the animal warmth of the poor in winter. Clothing is therefore to a large extent an equivalent for food; we cool less, and the amount of heat to be furnished to keep up the natural standard, is diminished. Those who fatten cattle know well the value of external warmth.

Nature abounds in instances of quantities of fat (*fuel* in reality) being stored up in animals for the starvation of winter, or a day of privation. The hunches of camels, the fat tails of Cape sheep, are illustrations; so is the Beccafico, which is so much esteemed in Italy, and if killed in winter is found to be "a lump of fat." Martell * relates that a fat pig buried beneath an avalanche of earth lived 160 days without food, and was found to have diminished in weight in that time 120 pounds. Hybernating animals are similarly protected. Lucky therefore is the individual, who, in a day of adversity and famine can draw upon so fortunate a commissariat, to battle with the giant consumer oxygen! All farinaceous and fatty food not consumed in the system, is stored up as *fat* in the animal economy.

* Trans: Linn: Soc: Vol. xi. page 411.

101. In very hot rooms, the equable temperature of the blood is threatened with violation; the air being rarified, less oxygen is consumed, and less heat therefore generated in the system. The venous system becomes loaded, difficulty of breathing ensues; and but for the burst of perspiration and its cooling effect, a variety of sequelæ might endanger the system. Those dancers who leave a hot ball-room to cool in an open corridor, or on an exposed terrace, must beware how they paralyze or interrupt the safety-valve and action of the skin, and engorge the respiratory organs; also, how they take ices, and suddenly arrest the protective secreting actions of the skin and mucous membrane. Many a healthy person invokes self-immolation by committing these violent acts of imprudence.

102. Liebig felicitously compares the system to clock-work, and that respiration is its pendulum; indeed the truth is self-apparent, for if we ascertain the weight of air expired, and count the number of respirations, we may calculate to some nicety the amount of aliment positively required and consumed in the twenty-four hours.

103. Not only does the surrounding temperature regulate our bodily furnaces by supplying expanded air in hot weather and condensed air in cold weather; and in the latter, possibly doubling the amount of oxygen in each inspiration; but the Great Author of nature presents to the inhabitants of cold climates, blubber, oil, &c. containing 80 per cent of carbon, and to those living in hot climates, fruits, &c. not exceeding 12 per cent of carbon.

104. Passive respiration is supported by the kind of diet alluded to; but exercise draws additionally upon the resources of the system. Every movement, every muscular effort is proved to be attended with the explosion of minute atoms of muscular matter or substance, Part of its composition, the carbon, unites with oxygen and becomes an additional source of animal heat and respiration. A man running, therefore, not only consumes the ordinary quantity and kind of fuel, but adds the decomposition of muscular fibre to that heat so generated, and to the amount of gases exhaled. A copious perspiration lends its aid under the embarrassment, and rids the system of a great portion of hydrogen (as water); and thus cools the internal heat by rapid evaporation.*

105. A humble bee was incarcerated in a bell glass, and being in constant activity during the excitement of capture, he produced in a single hour one-third of a cubic inch of carbonic acid gas. On the succeeding day he was at comparative rest, and generated in twenty-four hours a less quantity of carbonic acid.†

Animals, in a menagerie, move rapidly up and down their cages to promote the disintegration of effete tissues. Carnivorous animals consume more oxygen than those who live on farinaceous food, and keep up respiration almost entirely at the expense of the fleshly tissues.

* If the atmosphere is charged with moisture, this evaporation is obstructed,—hence the distress of asthma, and the feebleness of horses in autumn when the perspiration is condensed on their coats.

† Carpenter's Manual of Physiology, § 645.

Great muscular exercise is necessary to disintegrate the animal fabric; not only for the purpose of removing obsolete matter, and of generating warmth, but to perpetuate that motion and molecular force which is, most probably, intimately associated with the continuation of vitality. (§ 110.) Indeed, the nitrogenous compounds would soon accumulate in the body, and exert their well-known toxical effects on the system. Voracity is the impulse of those beasts of prey who inhabit the arctic regions: infinitely exceeding those of the torrid zone. How comparatively inert and docile are the herbivora.

106. Much of moral induction may be drawn from these details. Those who live in indolence and consume largely of animal food, become loaded with lithic acid, urea and other azotic impurities; are assailed with gout, local pains, rheumatism, skin and organic renal affections, which make the life of such persons one of perpetual misery; and singular enough, although the physician can see and point out the mode of certain cure, I scarcely ever have been able to induce such patients to abandon the indulgences of the table. Recommend such persons farinaceous diet for a month, with light albuminous food only and barley water! and they will either revoltingly refuse to comply with your advice, or clandestinely eat roast goose on a fast-day, and call it *fish!* "Doctor so-and-so could not cure me," (is a common expression; but it should be added) "though I confess I paid no respect to his dietation." None but homœopaths can enforce compliance with such *minute matters!*

107. It may be stated as a fact, that "in cold climates, air strives to consume the body." By gratifying the appetite thus excited, we obtain the most efficient protection against the most piercing cold. A starving man is speedily frozen to death.

The exercise of loud and long continued singing or reading, and the crying of infants, exert a decided and appreciable influence on the amount of food taken. Here let me highly extol those capital little exercising machines, "Baby jumpers," for the same reasons.

108. Any more minute manner in which the atomic combination of oxygen with hydrogen and carbon take place, we are unable further to explain. Yet some spontaneous combustions aid us with a little light. If fat or oil is distributed over a surface of woollen cloth, oxygen is rapidly absorbed, and so much heat is generated as to occasionally set them on fire.

Surface has much to do with oxidization, therefore also with the phenomena connected with respiration, an advantage which must be possessed by the capillaries to an extraordinary extent, for the point of the finest needle cannot enter the spot of skin where blood-vessels are not distributed,

109. It may now be readily gathered that if the supply of hydrogen and carbon should flag, that other proceedings must take place. The fatty substances being consumed, the progress of starvation proceeds. The muscles shrink and soften, the fleshy tissues succumb, "towards the end, the particles of the brain begin to undergo oxidization and delirium, mania and death close the scene."—(Liebig.)

110. Perpetual molecular change is the moving spring of life. Berthollet and Laplace laid down a law, that "an atom or molecule put in motion by any power whatever, may communicate its own motion to another atom in contact with it." Atoms of various kinds have their allotted residence in the body; they perform the functions assigned them, and depart to make room for others. As long as this series of actions takes place harmoniously, health is maintained; but whatever disturbs the regularity of these proceedings opens the door to disease of an acute or chronic character, according to the presiding circumstances. Liebig says, "Disturbed respiration is the end of all chronic diseases."

Every atom of the body obeys the law of deposit, decay, and removal after the appointed term of its existence. The demolition of muscular and nervous matter is much expedited by exertion.

111. All organized bodies are liable to decay (eremacausis), and their chief product is carbonic acid and water. Unhealthy plants give out more carbonic acid than they gain by fixation from the atmosphere. A very simple experiment will be a fit conclusion to these observations. If a small piece of decayed wood be placed in a closed bottle with a known quantity of oxygen and hydrogen gases, these gases will be found after a time to be diminished in the exact proportion to form water, and the wood will be discovered to have gained that additional weight of moisture.

CHAPTER V.

THE SKIN,—PERSPIRATION.

112. Perspiration performs manifold duties which are strongly correlative to those of the gastro-pulmonary mucous membrane. Its anatomical structure has already been described, (§ 36) and it now remains for us to consider those functions which relate to the excretory relief of the system.

The perspiratory apparatus consists of spirally twisted tubes of very minute, yet beautiful construction. They pierce the several layers of the skin, and terminate in small oval or globular glands, situated in the deepest cutaneous structure.

These tubes are lined with prolongations of the epidermis, which dip down and form their interior lining or sheath. Now when a blister is formed, the lining of the perspiratory duct is drawn out of its canal, hangs down like a sleeve, and acts as a long flapping valve, The pressure of the contained fluid effectually prevents any exudation. The fact of a blistered epidermis being impervious to fluid, led formerly to grave doubts as to the nature, and even the existence of perspiratory pores in the scarf-skin.

113, The products of perspiration are elaborated by the perspiratory and sebaceous glands, whereby the system is relieved of various matters, which, having performed certain beneficial services in the animal economy, are now become effete and injurious. It is truly stated that the skin and kidneys purify the arterial blood, whilst the lungs and liver remove the impurities of the venous blood.

Dr. Dalton fed an individual for some time on a daily allowance of 91 ounces of food, and he found the duties of the several organs interested, to have been performed by the following excretions:

	Water secreted.	Solids secreted.	Total egested.
Urine - -	45½ oz.	3½ oz.	48⅕ oz.
Lungs - -	20½ „	10¼ „	30⅔ „
Skin - -	6½ „	¼ „	6¾ „
Fæces - -	3¾ „	1¼ „	5 „
	76 oz.	15 oz.	91 oz.

Other physiologists have arrived at different conclusions. Lavoisier and Seguin estimated the exhalation of the skin at 8 grains in a minute, giving a total equal to 33 ounces in 24 hours. Simon says that the skin exhales in 24 hours about 5 scruples of organic matter, and 4 scruples of saline, and about 33 ounces of water. Recollecting the infinite number and variety of disturbing causes which affect the cutaneous action, as regards the quantity and quality of its secretion, it is not to be wondered that every observer should have arrived at a different computation.

114. The emunctorial powers of the skin must ex-

ceed all imagination; and I shall here quote Mr. Erasmus Wilson, as to the amount of duties performed by this vast organ.* He estimates the perspiratory pores or orifices, on an average, at 2,800 the square inch. Each tube being about a quarter of an inch long, it follows that in a square inch there is a length of 700 inches. Now the number of square inches of surface, in a man of ordinary bulk and height, being about 2500, the number of perspiratory pores are therefore 7,000,000, and the length of perspiratory tubes 1,750,000 inches; that is, 145,833 feet, or 48,611 yards, or nearly 28 miles.

It cannot be supposed that this great outlet can be interrupted with impunity, although influences external and internal are incessantly operating upon its activities, and varying the amount and nature of its eductions.

115. The perspiration contains all kinds of ingredients, animal matters, gases, acids (lactic 29 per cent. of the whole fluid, according to Anselmino), acetic, butyric, hydrochloric, lithic, phosphoric, and sulphuric; alcalies, calcareous earth, metals, salts, and probably sulphur. Considering the immense amount of substances coming under these several heads, it must be clear that, during a state of suppression, these matters must fall back upon, pervade, and distress the system.

These salutary perspirations may be vitiated by sudden and permanent accumulations, and then those troublesome cutaneous diseases arise, which so sorely

* On healthy skin, p. 53.

harass the patient, and often perplex the medical adviser.

116. I may here observe that many, if not most, skin affections, so far give evidence of the oppressive action of acid matters acting in their propagation, that alcalies and aliments which oppose acid formation are those found most efficacious in their treatment. Dr. Willan * says, " I look on solution of potass as a specific in the various species of psoriasis which depend on an irritable state of the primæ viæ."

117. The effects of temperature in disturbing the equanimity of the skin are multifarious. *Heat*, for the reasons given (§ 101), not only derivates the circulation to the capillaries and expedites molecular changes, but relaxes the pores of the skin, and invites cutaneous exhalations; the necessity for combustion is lessened, and the products, carbonic acid and water, are freely exhaled by the lungs and skin. That it has a counter action to that of the mucous membrane, is seen when diarrhœa is relieved by a hot bath, and a cold wet towel applied to the abdomen acts as an aperient in irritable dyspepsia—often being successful when all other aperients have failed.

Cold also suspends the action of the skin; and then the lactic acid, &c., pervades the system in excess, as is the case in rheumatism. No longer being discharged at the cutaneous surface, they frequently load the urinary secretions, and promote renal affections.

* Willan on Cutaneous Diseases, p. 141. See also Thomson's Materia Medica, p. 1087.

A *moist* atmosphere introduces infectious matters and miasmata, which traverse the skin without any impediment. The absorbing action of the skin is often of great value to us. In impediments to swallowing, persons have been kept alive for a long time by sponging the body with warm milk and water.

Alcaline baths strongly promote cutaneous reaction, whilst salt-water baths *exosmose* exhalations (§ 34).

A cold moist atmosphere prevents cutaneous exhalation (§ 104), and the pulmonary mucous membrane becomes much congested. In cold *dry* air, moisture is rapidly evaporated (§ 27).

118. The skin relieves the system in three ways :— 1st, by desquamation ; 2nd, by perspiratory glands ; 3rd, by sebaceous (oil) glands. It has been said, that the health of the skin depends on four auxiliaries— clothing, towels (friction), soap, and water. Sir William Temple was supported by fact, in saying, " No man need have the gout who can keep a slave to rub him."

119. Innumerable instances can be introduced, to shew how close is the alliance between the skin and the gastro-pulmonary mucous membranes. Drinking a glass of cold water, if the skin is kept warm, will produce copious perspiration. A hot air-bath will relieve congestion of the pulmonary mucous membrane. Poisonous fish (mussels, &c.) produce nettle-rash. Cold water sponging, in scarlatina, promotes all the secretions. Burns and scalds cause inflammation of the lungs, if their full action is suppressed. Many cutaneous dis-

orders cause nausea and vomiting, with great pain in the stomach. The effect of chill on the skin is to suppress also intestinal action; for constipation always at first takes place with a cold; but if this chill occurs in a febrile state of the system, some part of the gastro-pulmonary mucous system takes on excited action, as in bronchitis, and in the intestinal inflammation which frequently supervenes in measles.

120. The following laws may be said to arise out of these considerations.

First. The diseases of a part of a membrane may spread over the whole, as in erysipelas, and other exanthemata.

Second. Diseases of the mucous membrane may extend to the skin, and vice versa; as herpes labialis, &c.

Third. Diseased actions of part of a mucous membrane may be translated to a distant part of the skin, and vice versa; as poisonous fish producing nettle-rash; acne (blotches) of the face, arising from dyspeptic causes; suppressed cutaneous action, producing water-brash (pyrosis), and other forms of dyspepsia.

Fourth. The functions of either (skin or mucous membrane) being interrupted, the other is embarrassed and its duties disturbed. (§ 119.)

121. "Colds" are considered the frequent forerunners of all diseases; and this arises from the impossibility of foretelling how and to what extent the system may suffer. Chills act in a variety of ways, but are modi-

fied in their action and effects by various circumstances, such as—

1. The predisposition of the patient to disorders of the other depurating organs (the lungs, bowels and liver, kidneys, &c.), which become embarrassed by greater weight of duties.

2. Or the accumulation of lactic acid (the chief cutaneous material) in the system, and causing rheumatic and other local painful affections.

3. Or whether any locality may be predisposed, as the eyes, nose, throat, uvula, tonsils, &c.

4. Or, being asthmatic and ripe for febrile action, whether the effects may be general febrile action, or local congestion, irritation, or inflammation.

5. Or whether the effects be depressant; and low catarrhs, or morbid secretions from the mucous surface, may be the result.

Lastly; much depends on surrounding circumstances, especially on the nature of the winds, or the temperature, and moisture, to which the patient has been exposed.

CHAPTER VI.

SYMPTOMS AND TREATMENT.

122. It is not to be wondered that the limited knowledge of our forefathers led them to build up theories of the most ludicrous and apocryphal character, and that the pseudo-philosopher should have esteemed the hobby he had adopted as a panacea for "all the ills that flesh is heir to;" or, on the contrary, as being the *casus belli*,—the *materies morbi* of all human infirmities.

Scepticism and credulity often ran mad and attempted to outvie each other; whilst sensible, calm-thinking men were unable to sift the truth from fiction, and to combat, for want of materials, the chimerical doctrines put forth by the self-constituted savans of the day.

Lactantius, with every confidence in his scientific authority, opposed the then newly advanced theory of the spheroidal shape of the earth. "Is there any one," says he, "so mad as to believe that there are men whose feet stand opposite to ours? and who are able to walk with their feet upwards, and their heads hanging down; that there is a part of the world where all things grow topsy-turvy; where the trees grow with their branches downwards, and where hail, snow, and rain

fall upwards?" Such is now a demonstrated fact; and it has been well said that "in our schools mere children are now taught truths the attainment of which has cost immense labour and indescribable efforts."

Although scepticism is salutary in the end, yet it has in all ages deprived men of research and ability, of a vast deal of that credence and merit to which they were fairly and honestly entitled, but to whom a more enlightened subsequent generation has accorded a proper meed of posthumous fame.

123. Some individuals have believed that all diseases were the result of *acids* generated to excess in the human system; whilst others contended that the opposite condition was the true morbific agent, and that preternatural *alcalinity* of the fluids was the actual cause of diseases. And really these disputants had much subtle argument on both sides, considering that the same mucous-membrane secretes *alcaline* mucus and (almost in the same place) *acid* saliva. That the liver and pancreas largely eliminate *alcalies*, whilst the kidneys in health secrete an abundance of *acids*. The blood also is necessarily *alcaline*, whilst "the juices of flesh (according to Berzelius, supported by Liebig) contain *lactic acid*." *

Indeed the system abounds in free and combined acids and alcalies, in one grand chaos of torrents and rivulets; yet every particle floating in these streams is filtered off before it has completed the circulation of the body, and each one is appointed to its own especial

* Dr. Golding Bird, Urinary Deposits, p. 91.

purposes in a manner incomprehensible to human understanding.

124. These chemical matters are subjected to influences apparently most trifling. Even our usual articles of diet exert a power that we little suspect. By choice of food alone we can increase the amount of acid matters formed in the system to an extent much exceeding the healthy proportion, with but little injury to the system ; and by dietetic means can considerably suppress the normal acidities, and give certain secretions an entirely *alcaline* re-action. So that the advocates of either of these specialties relied for the maintenance of their dogmas chiefly on the weight of illustrations which the disputants respectively had at their command.

As instances, it may be mentioned, that a large amount of flesh food often provokes a considerable formation of lithic acid,* which acts poisonously on the system (as in gout and local pains), whereas other articles of diet, as roasted-apples, strawberries, currants, and champagne, change the fluid alluded to, to an *alcaline* condition.

Many of these substances are consistent with health, whilst in certain moderate proportions, and so long as they abide in their proper residences, but which act toxically when in excess (as lithic and lactic acids), or when they migrate to regions to which they are alien and offensive, (as sugar in diabetes and bile in jaundice).

125. In the wonderful corporeal laboratory which we inhabit, are elements of all descriptions. We have four

* Müller's Physiology, p. 161.

extremely combustible materials disposed over every part of the system. Two of these, hydrogen and carbon, burn with rapidity, but with that subdued combustion that no fabric is injured so long as health guides the process. The other two, sulphur and phosphorus, are not so freely expended; they enter into important combinations in the formation of various animal tissues, and take an active part in many processes of organization.

It is difficult to believe that without sulphur and phosphorus we could neither have shape nor solidity; and, if such a thing were consistent with vitality, we could never advance beyond a state of pulp, and should positively be without any membrane or living bag to put it in! An egg could never have organic existence or have been an egg at all, without sulphur and phosphorus.

One of these combustibles is consumed in the formation of water; the other three in the formation of acids, (carbonic, sulphuric, and phosphoric); so that the elaboration of acids is intimately concerned in our existence, and is never standing still.

126. The fading tissues, casting off particles of their substance in every spot and in every organ, are perpetually entering into fresh compositions favourable to their issue from the system, and are thus the legitimate sources of numerous acid and other effete compounds.

Certain ingredients seek preferentially certain residences, in their travels through the economy. Bone-earth seeks its deposit in the bony structure; potassa,

the pancreas; soda, the liver; * and phosphorus, the brain † and nerves.

Nitrogenous refuse matters are removed chiefly by the skin and kidneys; carbonaceous compounds chiefly by the liver and lungs; and I think I may safely say, that lactic acid is depurated chiefly by the skin and mucous membranes.

127. I shall now take a slight retrospect of the process of digestion. Dr. Beaumont found that the mucous membrane of the stomach, when unemployed, was of a pale pink colour; that, immediately food was introduced, the vessels became more injected, as is the case with the conjunctiva of the eye, on the application of a foreign body, and that its colour became changed from *pale pink* to *deep red*. A pure, colourless, slightly viscid fluid, with distinct acid reaction, was then observed (through the opening in St. Martin's stomach) to distil from the surface of the membrane, and to collect in various points, trickling down the wall of the stomach, till it mingled with the food. During *fasting*, no such fluid was observed; only a *viscid mucus*, occasionally slightly *acidulated*, and which effervesced with *alcaline carbonates*.

128. From these observations we come to the conclusions, that by irritation of the mucous membrane it gradually heightens in vascularity, from pale pink to

* Ashes of blood contain 78 per cent. of Soda. Bowman's Medical Chemistry, p. 155.

† "Phosphorus comprises from 1-20th to 1-30th part of the whole solid matter of the Brain. It seems to be universally deficient in the Brains of Idiots. Carpenter's Physiology, § 383.

deep red; that the latter state is one of active secretion; that pepsine (the active principle of gastric juice) is only secreted when food is present; and that a free acid is occasionally eliminated during fasting. As nervous excitability is the presiding influence over vascularity, our conjecture is realized by experiment, that the vascularity of the stomach—the reddened secretive state—depends on the exalted sensibility of the gastric nerves. That when food is present, pepsine is elicited; but when no food is present, any heightened vascularity of the stomach leads to the secretion of *acidulated viscid mucus*. Now let us examine the testimony relating to these propositions. We have been told that any considerable excess of acid, in relation to the pepsine secreted, arrests digestion as well as the opposite or scanty supply. Now if these states can take place in the human system, what are the symptoms and what the causes? Neither Dr. Beaumont, nor any other writer, to my knowledge, has given any elucidation as to the causes and symptoms of the morbid secretions of acids *when fasting*.

129. Notwithstanding the ascribed "intelligence" of the stomach (§ 51), it cannot distinguish the presence of nutritious food from that which is innutritious (§ 53); but it obeys the well-known laws of the animal economy in regulating its own action and secretiveness, in a ratio according to the amount and degree of stimulating matter presented to it. Food is the *natural* stimulant; and when food or any foreign body is present, and only then, is gastric juice secreted. Dr. Beaumont found

that even the bulb of a thermometer excited a slight secretion of gastric juice; and "Reaumur, taking advantage of this fact, made animals swallow sponges, which he could draw out of their stomachs with strings attached." *

130. In certain forms of dyspepsia, pepsine (the active principle of gastric juice) is not secreted even by the natural stimulus—food; for Dr. Beaumont observed that, under some disturbing circumstances, "the mucous coat of the stomach became *red and dry*, and at other times *pale and moist*, and lost altogether its smooth and healthy appearance. As a necessary consequence, the secretions became vitiated, impaired, or entirely suppressed." † It is perfectly clear, that in the absence of any definite knowledge, as to the secretion or suppression of free acid, Dr. Beaumont recognized *the phenomena*, though he was unable to explain the conditions to which I have referred (§ 57 and 58). Nor do I know of any writer who has in any way further alluded to, identified, or explained these respective states of the mucous membrane. Yet there are lots of testimony of an oblique character in allusion to them. Dr. Golding Bird says,‡ "In irritative dyspepsia with pyrosis, a large proportion of free acid is generated in the stomach." And again, "the acid thus generated in the stomach by disease is often considerable, far exceeding the proportions poured out during healthy digestion." But these

* See Todd and Bowman's Physiology, Part III, p. 198.

† Physiology of Digestion, by Dr. Combe, p. 48.

‡ Urinary Deposits, p. 153.

observations also leave us to explain the symptoms and pathological condition attending the excessive secretion of free acid in the stomach, *without pyrosis*, which all writers seem to have associated with acidity of the stomach in dyspepsia. Dr. Bence Jones bears testimony to the fact, and there he leaves us. "Common salt," says he, "promotes the secretion of acids by its irritation of the mucous membrane of the stomach." It remains for us to identify the causes of this undue secretion, and to recognize its manifest effects on the system.

131. There are clearly various shades of *excitability in the mucous membrane*, between that pale pink preceding a glass of barley-water, and the deep red following a basin of highly-seasoned turtle-soup. Our sensations tell us that a rump-steak is more "satisfying"—that is, more stimulating, than a slice of boiled Sole; yet these all abound in strictly nutritious matter. The tongue, too, with the Sole and barley-water retains almost its usual colour, but becomes watery and florid-red after the turtle-soup and rump-steak. Now the tongue is a faithful telegraph of the state of the stomach. Dr. Samuel Wright notices this state of the tongue, but he fails to identify the state of stomach which it illustrates. He says, "Others again will have clean tongue, and of natural (?) redness, whilst they are suffering from severe stomach disorder. I called your attention to a case of this sort the other morning, in the person of a female, the subject of very severe pyrosis."*

* Lecture on Morbid States of the Tongue, by Dr. S. Wright, Birmingham.—Medical Times: Dec. 26, 1846.

The fore part of the paragraph refers clearly to the action of free acid in the stomach, although unrecognized. Dr. Wright notices also the opposite state, without comment: " The pale, flabby, sodden tongue of habitual drunkenness, debility of the gastric apparatus, &c." Here is evidently pourtrayed the tongue of what we identify as the *acidless* state of the stomach.

132. Dr. Beaumont tells us, that soup rejected by vomiting, from its richness, is invariably acid; and Dr. Guy says, " Lactic acid is probably the chief ingredient of acid liquors rejected from the stomach." * Wine and other *acid* liquors speedily lead to emetic effects in the irritable stomach, which is not the case with *alcaline* fluids, as soda or potass water, although a quantity of spirit, equal to that of the wine, is added to them. The effects of spices, bitters, acids (" hard ale "), &c., before and during meals, are those which excite the reluctant secretion of acid, and are successful only with those whose digestive organs are apathized by habitual indulgence or disease. Here are ample illustrative facts of the cases imperfectly described (§ 57 and 58.) The effects of a debauch on two such opposite cases are these,—the irritable florid tongue indicates a necessity for the administration of alcaline drinks; the pale, flabby, sodden tongue points to comfort only from strong green tea, acid beer, spirits, and salted food. Dr. Beaumont states that " an hour after giving St. Martin nine ounces of *raw sour apples*, the stomach was full of fluid and pulp, quite acrid, and which irritated the edges

* Hooper's Practice of Physic. Edited by Dr. Guy, p. 53.

of the aperture, as *is always the case when he eats acescent fruits or vegetables.*"

133. *Excited or febrile states of the system* are fertile causes of undue acid secretion. An infant has a cold or is teething; it repeatedly throws up curdled milk, highly tainted with acid odours. It has griping pains, and a diarrhœa characterized by the same acid fœtor. A small alcaline dose cures it.* Entozoa (worms) create irritation in the intestines. The acids secreted by the mucous surface, act in the manner peculiar to them; they coagulate the albuminous portion of the secreted mucus, which adheres in a plastic manner to the plicæ or folds of mucous membrane, and thus it forms a congenial habitat, or nidus, for the residence of those most troublesome intruders, (§ 73.) As alcalies re-dissolve albumen, (§ 66) this reasoning suggests the free use of alcaline drinks before and during the operation of vermifuge medicines. Dairymen know that a heated cow's milk speedily turns acid. Dr. Beaumont notices that in the febrile state produced by *dry* air, the stomach of Alexis St. Martin became *exceedingly red.*†

134. *Fermentation* is performed in the human stomach much in the same way as it is under other or ordinary circumstances, and leads to the conversion of farina, and sugar taken as food, into lactic acid. This extra source of acids causes a retroversion of acidulous

* Alcaline Baths are of great service in these and in other cases of irritation in the digestive organs.

† Combe, op. cit. p. 59.

action again upon the peccant mucous membrane. Fermentation is a peculiar process of rapid decomposition, and re-arrangement into other substances; the agent which sets this proceeding in action is termed *a ferment*, and its only necessity is that it should contain nitrogen in its composition, and be itself in "a state of change," (so chemists describe it.) When fermentation is once set in motion, any fluid containing a nitrogenous element continues that action; the plastic matter acting as an impromptu ferment. Liebig says,* "The skin of animals and the mucous membranes have many properties in common with gluten and yeast." The scum ("skimmings") of preserves, which consists of albumen, is removed, or it would soon constitute a ferment in warm closets. As a tea-spoonful of yeast sets in fermentation a hogshead of beer,† so a slight acescent condition of the gastric mucous membrane is an effective excitor of that process. "Lactic acid can be readily formed out of the body, by allowing a solution of sugar to ferment in contact with an animal substance in a state of change, such as the mucous membrane of a calf's stomach,—rennet." ‡ By ordinary fermentation, farina is converted into sugar (malting); sugar into alcohol; and alcohol into vinegar; but if the ferment is itself only in an incipient or feeble "state of change," then sugar is not converted into alcohol, but into lactic acid.§ Now it was previously

* Letters on Chemistry, page 202.

† In malt liquors, all the plastic matter of the malt is consumed as erment.

‡ Uninary Deposits. Dr. G. Bird, p. 93.

§ Liebig's Animal Chemistry, p. 36.

stated (§ 48), that saliva had the power of converting starch (farina) into dextrine (gum) and sugar; dextrine being probably the first stage towards the formation of sugar, so that farina reaches the stomach in this acidulous diathesis possibly entirely converted into dextrine and sugar by the saliva, and prepared for fermentation into lactic acid.

135. We will now take a glance at the composition of these substances, and it will be seen that the proportion of hydrogen and oxygen in each article is equal to form water, and that *their* variation constitutes the only difference, the quantity of carbon remaining stationary.

	Carbon.	Hydrogen.	Oxygen.
Starch (farina)	12 volumes	10	10
Cane sugar	12	11	11
Gum	12	11	11

By this it will be seen that 12 volumes, or measures of carbon, and 10 measures of (hydrogen and oxygen) water are the components of starch, and so on with cane-sugar, and gum. Now lactic acid is a smaller looking substance, and is composed when dry, of 6 carbon, 5 hydrogen, and 5 oxygen, but if these figures be doubled, and (1 of hydrogen and 1 of oxygen) 1 of water is added, it has the same composition as gum and cane sugar, C 12, H 11, O 11;* therefore the conversion of sugar and gum into lactic acid is more a functional confirmation peculiar to chemical endowments

*. Pereira on Food and Diet, p. 22.

than to such substantial changes as would appear necessary to one uninitiated in physiology and chemistry,—such an one as is ignorant that pure charcoal and diamonds are identical in chemical constitution.

136. The question may be asked, how can biscuits contain such an abundance of water and be in a perfectly dry state? I will explain this by a very good illustration. Slaked lime, is lime saturated with water, which combines with that earth, and increases its weight to the exact amount of the water so absorbed; a new apartment coated with this material exhibits no moisture on its walls, but if carbonic acid be generated in that room, either by the respiration of individuals, or by the combustion of a stove or candles, the carbonic acid unites with the lime forming carbonate of lime, and displaces the water used in slaking, which trickles down the walls. Previously to the introduction of the carbonic acid, the water existed in a *dry solid* state in union with the lime. Here then is water held in dry combination made manifest as a fluid by other agencies. We now see how biscuits relieve thirst, and by furnishing a large supply of carbon protect from chill, and as containing alimentary materials protect us from hunger.

137. Dr. Golding Bird says, "The composition of lactic acid bears so simple a relation to that of some of the most ordinary elements of our food, that its presence in the secretions, at least under many circumstances, might really be anticipated." * Lactic acid is positively a constituent of the juices of flesh.†

* Urinary Deposits, p. 93. † Dr. G. Bird, Op. Cit. p. 91.

If the carbon and hydrogen which are burnt in the system, combine with only a limited supply of oxygen, or the oxygen is indisposed to unite with both these elements, then by devoting the whole of the oxygen to the hydrogen forming water and leaving the carbon free, lactic acid is the result. By oxidizing lactic acid, we re-produce carbonic acid and water. By removing two-thirds of the oxygen from carbonic acid and water, we again form lactic acid. So that lactic acid, and the products of the combustion of carbon and hydrogen in the system have a reciprocal play of affinities and productions.

138. Whatever abnormal action may be taking place in the capillary blood-vessels, excessive *mental exercise* has the power of exalting these organic functions. We observe, in blushing, the influence of the mind on these minute vessels, how passion increases the temperature of the body, and how great mental perturbation produces copious perspiration. The ordinary sensibilities are much heightened by incessant toil of intellect, and the diatheses are provoked into action.

In reference to the lithic acid diathesis,

"Gout kills more wise men than fools," says Sydenham.

"It attacks men of large heads." Cullen.

"It is peculiarly incidental to men of cultivated minds and intellectual distinction." Dr. Watson.

139. Acids, &c. often pervade the system in their own identical form. "In the case of a pregnant female who was poisoned with sulphuric acid, and gave birth to a child in the expiring throes of life, sulphuric acid

was detected in the body of the infant, and in the maternal fluids."* "The urine is always most acid when the stomach is most acid."†

All mothers are doubtless aware of the effects of their taking acid food, or unripe fruit, in causing distress to their infants, of precisely that character which is detailed (§ 133) as the result of exciting causes acting on the infantile systems. I once saw a baby griped and made sick by the mother having drank sour ale only eight minutes previously; the distress of the infant was most pitiable, but was instantly relieved by a little carbonate of soda.

THE LACTIC ACID DIATHESIS.

140. The term Diathesis in Medicine means "a natural predisposition to certain diseases,"—as the tubercular and cancerous diathesis. It is also applied to certain urinary deposits, whose presence in the circulation leads to disturbed states of a most obdurate and distressing character. Of the latter class we have the lithic acid diathesis, the oxalic acid, and the phosphatic diatheses; each term implying that those several substances pervade the system in excess, and produce certain morbid phenomena. The two latter are diagnostic of an enfeebled constitution, the former one of the contrary.

141. I trust the grounds which I shall detail for

* Thomson's Materia Medica, p. 1153.

† Animal Chemistry, by Dr. Bence Jones, p. 41.

‡ Called Lactic Acid, as being that formed in sour milk, not peculiar to milk alone as now determined.

instituting an additional diathesis will be considered conclusive, and supported by fact. We will take the two following as being most parallel.

Lactic acid is composed of carbon 6, hydrogen 5, oxygen 5 measures.

Lithic acid is composed of carbon 10, hydrogen 4, nitrogen 4, oxygen 6.

The former is therefore identified with the composition of farina, gum, sugar, &c.; the latter with animal substances, possessing the four elements of which flesh is composed.

Lactic and lithic acids differ in this other respect, that lactic acid is perfectly soluble, and never can be detected as a deposit; whilst lithic acid is soluble only to the extent of 1 part in 10,000 parts of cold water, according to Carpenter;* 1 in 15,000, according to Bowman.†

142. Whatever changes the food may undergo before it is absorbed into the circulation are denominated *primary assimilation.* The changes which these alimentary substances are subjected to subsequently in the body, as in secretion, repair, removal, &c., are termed *secondary assimilation.* This secondary process may be deranged; and instead of those changes taking place as they do in health, abnormal products may be generated (as lactic and lithic acids); or substances may pass through the capillary vessels unchanged (when they ought to have been) and pervade the system, as

* Carpenter's Physiology, § 732-3.

† Bowman's Medical Chemistry, p. 6.

sugar in diabetes, and bile in jaundice, and produce their well-known injurious effects.

143. Urea (C^2 H^4 N^2 O^2) is the natural soluble compound arising from the decay or destruction of the animal tissues; but if it is controlled by morbid influences, lithic acid is generated in its stead, a substance containing a less proportion of oxygen.

Carbonic acid and water are the healthy products arising from the combustion of farina, sugar, &c.; but, influenced by morbid agencies, lactic acid is formed, containing two-thirds less of oxygen than the two natural compounds.

144. Urine contains about 1·grain of lithic acid in 1000, being 10 times more acid than is soluble in 1000 grains of cold water, according to Carpenter. More than this proportion is deposited probably in the various parts of the body, giving rise to local pains (and may be facetiously termed "gravel-pits"), or unites with the soda in the blood, and forms gout or chalk-stones (lithate of soda) in the knuckles.*

To an abundance of lactic acid in the system are usually attributed rheumatic affections. An excess of either acid is prejudicial to health.

Now if either diathesis is once established, the tendency is not easily checked, and farinaceous, saccharine matters, &c., continue to be converted into lactic acid, and animal substances into lithic acid.

* Iodide of potassium dissolves lithate of soda. I have seen gouty swellings of the knuckles dispersed by its use as a lotion, poultice, or ointment, aided by friction and pressure,—*and diet.*

145. By tabulating a comparison between these two diatheses, we shall the better judge of the propriety of creating the new dignity of a lactic acid diathesis.

LACTIC ACID	LITHIC ACID
1. Is generated in the periphery of the circulation.	1. Is generated in the periphery of the circulation.
2. Is found in the blood. "Lactic acid is found in the juices of flesh." *	2. Is found in the blood. "The lithic acid diathesis is due, not to disorders of the kidney, but to an undue production of lithic acid in the blood." *
3. Is owing to mal-assimilation of respiratory materials. "Thus an excess of farinaceous food which furnishes sugar and lactic acid faster than they can be thrown off, as carbonic acid and water, favours the formation of lactic acid in the system.†	3. Is owing to mal-assimilation of plastic materials. "The quantity of lithic acid is increased (by mal-assimilation) in quantity merely by taking animal food."†
4. The excessive formation of lactic acid is caused by irritation in the stomach. See Cases in this book.	4. The excessive formation of lithic acid is caused by irritation in the stomach. "Whatever generates free acid in the stomach, favors lithic acid deposits."‡ "Berzelius gives a case in which phosphorus was given, and the urine deposited lithic acid, so long as the drug produced irritation in the bowels, and no longer, though the dose remained unaltered."§

* Golding Bird, op. cit. p. 91.
† Carpenter's Physiology, § 735.

* Carpenter's Physiology, § 422.
† Müller's Physiology, p. 161, 636.
‡ Dr. A. T. Thomson's Materia Medica, p. 1151.
§ Dr. Prout's Enquiries into the Nature and treatment of Gravel.

LACTIC ACID.	LITHIC ACID.
5. Acid food rouses the diathesis and causes the rapid elaboration of lactic acid. See Arguments and cases recorded in this book.	5. Acid food rouses the diathesis and causes the rapid elaboration of lithic acid. "All acids, even the weakest, as carbonic acid, precipitate lithic acid." * Effects of port wine, &c.
6. An accustomed outlet being stopped up, an insalubrious redundancy ensues. Effects of chilled skin.	6. An accustomed outlet being stopped up, an insalubrious redundancy ensues. Berthollet found a diminution of lithic acid in the urine followed by gout. Dr. Garrod confirms this.†
7. Symptoms. Dyspepsia, often with rheumatism. The gastro-pulmonary mucous-membrane chiefly affected.	7. Symptoms. Dyspepsia, gout. The Genito-urinary mucous-membrane chiefly affected.
8. Treatment. Alcalies neutralize the acid and correct the diathesis.* Diet—bland, free from exciting or acid ingredients: attention to skin, clothing, climate and exercise.	8. Treatment. Alcalies counteract the diathesis. Alcalies increase the solubility of lithic acid. Lithate of potass is soluble in 85 times its weight of *hot* water. Lithate of soda soluble in 124 times its weight of *hot* water.‡ "Solution of potass counteracts the red lithic acid deposit." § Diet—bland, free from acid or exciting ingredients. Attention to skin, clothing, climate, and exercise.

* See the chapter on food and dietation, for further information.

* Carpenter, op. cit. § 732, 733.
† Spencer Wells on Gout, p. 11.
‡ Bowman's Medical Chemistry, p. 7.
§ Dr. A. T. Thomson's Dispensatory, p. 1024.

I think these are good grounds for conferring on the elaboration of lactic acid, and its effects on the human system, the denomination of "The Lactic Acid Diathesis." And this term I shall now use, as we proceed.

146. So much must now have been gathered of the symptoms arising from the lactic acid diathesis, the various ways in which it is aroused, and the circumstances to which it responds, that I shall endeavour, first, to personify its mode of action; and then give those symptoms in detail, which are the effects of East and North-East Winds on the human body.

Case 1.—A person has flushed and hot cheeks after a meal, vastly depending on the acid or irritating nature of the food, usually attended by constipation. The tongue is of a *florid lake-colour* (the best description I can give—being no painter). As may be expected, rich soups (§ 132), wines, beer, and other acid fluids, disagree, as well as the richer and fibrinous meats.

The administration of an alcali removes the flush from the cheeks, and reduces their heat to the natural standard. It also acts as an aperient, though it does not do so under other circumstances.

Unripe oranges, acid preserves, acid lemon-drops, the carbonic acid of simple aërated water, all excite the diathesis, which is especially called into action by them, and indeed all these symptoms are much aggravated, by East and N. E. winds.

Case 2.—A gentleman tells me that E. or N. E. winds produce a sense of heaviness, swelling and tightness in the head, sudden *flashes* of giddiness. He feels occasionally faint, has lost health, strength, and appetite; has deficiency of memory, restless in sleep—perhaps but little. Is fidgetty—possibly

fretful and excitable in temper, and has great depression of spirits; perhaps a great flow of saliva during the night, flooding his pillow.

Here the disturbance is chiefly cerebral, of an active kind.

Case 3.—A person has flushed cheeks after meals, and after dinner cannot possibly combat the tendency to sleep. Feels dull, heavy, can enjoy nothing, and has no pleasurable prospects. Disinclined for study; and the memory is most transient.

Case 4.—Complains of a husky full sensation in the larynx, and as though the mucous membrane was swollen. These symptoms attack him the moment the wind is in the E. or N. E.; and he is perhaps awoke in the morning by these unmistakeable afflictions of one of those particular winds. A sense of suffocation gives an anxious character to his features. His breathing is short and oppressive, a wheezing rhonchus is heard in his throat and chest, his inspirations are laborious, he stretches his neck in forced inhalations, and looks and feels the picture of misery. He tries all kinds of food and physic—nothing relieves him. Brandy discomforts him the least, as containing less acid than any other liquors; and he flies to it after meals, to relieve his distress,—but in vain.

The dietetic and medicinal treatment which I shall point out as we proceed, will entirely remove or cure the lactic acid diathesis, *in which alone* (in

the absence of organic disease) these cases can possibly exist.

Case 5.—Suffers during the prevalence of E. or N. E. winds, from palpitation of the heart, often of a peculiar tumultuous fluttering character, especially after meals, on turning in bed, and on walking. Occasionally pains in the region of the heart, &c.*

Case 6.—For years has suffered from what he calls asthma, which comes on especially after acid or exciting food; he dreads an E. or N. E. wind, which nearly suffocates him. The tubular respiration in the larynx is most sonorous.

The laborious inspiratory efforts of the muscles, so brought into action, add to the pains in the chest, before and behind; and as the larger bronchi soon take on the same state of excitement, the roar of his breathing can be heard in an adjoining apartment. The lactic acid diathesis is so marked in these cases, that they may be relieved or aggravated almost at pleasure by alcalies and acids. An appropriate diet is indispensable.

Case 7.—Expectorates pints of watery saliva in 24 hours; and the patient tells you it has a salty taste (the acid fluid in pyrosis—water-brash, has a

* In a beautiful Lecture recently delivered by Dr. Marshall Hall at Manchester "On the Spinal System and its Diseases," he says, "The spinal marrow is the conductor of the influence of *undue acidity in the stomach* when it affects in a reflected manner the *action of the heart*—a subject requiring new and careful investigation."—Lancet, Nov. 11, 1854, page 392.

salt taste). The injurious effect of *vegetable* acids, in these cases, is remarkable. There is generally a most enfeebled constitution, and bloodless appearance of the system. The sesquicarbonate of ammonia (a most valuable alcali), supported by that unexciting preparation the ammonio-citrate of iron, are the only remedies on which I most confidently rely, with (and I must strongly insist upon this subject) *a proper diet*.

Case 8.—A lady had an ulcer at the back of her heel; it was highly sensitive, and of a vermilion-red colour. The state of her system indicated the lactic acid diathesis. She was treated accordingly; and in a very short time this troublesome sore of fourteen months standing was perfectly healed.

Cases of local pains, numbness and cramp of the limbs, depraved sensations, weak eyes, ear and toothaches, nasal fluxes—often of a most offensive character to the patient, many cutaneous affections,* particularly in the face, and obstinate eructation, are highly amenable to the aggravating agency of E. and N. E. winds, acting upon the lacticacid diathesis. I may also add, that in this state of system, hysteria in females often developes itself; and, from my own observations, I think that a similar state of another mucous system is the chief source of hysterical disorders.

* The value of alcalies in the internal and external treatment of cutaneous affections is known to every one; and I firmly believe that ninety-nine out of a hundred of those whose cases are believed to be incurable, owe their want of success to impropriety of diet.

These are a few classes of cases, taken from my note-book, in which I recognize the lactic acid diathesis; and I believe them to be *perfectly curable,* when not complicated, of course, with organic disease.

147. The following is a catalogue of those very distressing symptoms, which usually appear in those who suffer severely from the violence of the E. and N. E. winds, varying to some extent, according to the sex, age, habits, and climate, appertaining to the patient.

Headache, sudden *flashes* of giddiness, occasionally fainting.

Impaired memory, nervousness, restlessness, and petulance.

Depression of spirits, gloomy apprehensions.

Conjunctivæ reddened, glassy and irritable in strong light, flying specs, and *bewildered* vision.

Cheeks hot and flushed, it may be in patches or on one side chiefly; at other times, pale muddy, and anxious.

Lips, nostrils, and eye-lids much reddened.

Flow of watery saliva at night, flooding the pillow.

Nasal discharge, sometimes most offensive to the patient: at other times a sense of fetid odours.

Tongue of a florid or reddened-lake colour (not the "beefy" tongue of inflammation), clean, watery, and soapy. It feels rough against the roof of the mouth, from projection of the papillæ, and the absence of mucus, and the presence of watery acid saliva.

Speech occasionally thick, especially after food.

Breathing much embarrassed; choking, swollen, woolly, suffocative sensation in the wind-pipe.

Voice husky; a raking, clearing cough, of a sonorous laryngeal character.

Deafness, from the dry state of the epidermis lining the ear.

Tumultuous palpitation of the heart.

Cutaneous eruptions on the face much aggravated, especially acne and eczema.

Distension of the stomach after meals, which almost instantly subsides on the administration of an alcali.

Irresistible sleepiness after dinner.

Oily and fatty matters disagree; as the alcaline action of the bile is antagonized by the excess of acid in the stomach.

Even the weakest beer creates distress, from its acid composition; and salt, from its irritation (§ 130).

Constipation, of a dry and most obstinate character, generally aggravated by aperients.

Craving hunger, possibly without relish or enjoyment, too often followed with great discomfort.

Pulse soft, quick, and irritable.

Wounds or abrasions put on a highly florid, tender, and unhealing appearance.*

* A medical officer in the Crimea states that "on the prevalence of southerly winds, wounds became hot, red, and irritable,—showing little disposition to heal."—Times, November 8, 1854. Now these winds passing over the dry sands of Egypt, Nubia, the Libyan deserts and Arabia, are of the same character as our N., N.-E. and E. winds, but are hot in addition to their dryness.

The back, the shoulder-blades, and sometimes the space between them, become the seats of severe pains, extending along the muscles at the back of the shoulder and arm.

Numbness of arm and leg, on one or both sides; "pins and needles" in the fingers; frequently a limb is nearly paralyzed.

Pains in the chest, back, and loins.

A peculiar *stream* of trembling debility, or "bubbling," down the front of the thighs, often felt even when sitting still.

It must not be supposed that the whole of these symptoms should infallibly be present in every case. They are the category of morbid conditions usually manifested under the influence of these exciting causes.

148. The E. and N.E. winds are usually accompanied by a very *cold temperature;* but I never knew a sufferer from them who did not declare that he could tell when the wind was in either of those points, as soon as he awoke in the morning, by the manifestation of his complaint, and therefore had not left his bed or been exposed to any cold whatever. Indeed a heated apartment confers no immunity from these merciless assailants.

149. I have before pointed out the vastness of the perspiratory apparatus, (§ 114) the large quantity of effete matters discharged by it, (§ 113) that lactic acid formed a considerable portion of their composition, (§ 115) and that each perspiratory tube was lined by a sleeve-like prolongation, or sheath of epidermis. I previously described the histological structure of the

epidermis, which, like the epithelium, is composed of cells, flat, dry and scaly on the surface, moist and globular beneath (§ 36).

We have many instances of disease arresting the emunctorial functions of the skin, followed by a rapid exfoliation of the epidermis as in scarlet fever. The same takes place as the effects of the E. and N.E. winds drying up this cell-structure, whereby the office of the skin is abolished, and its conduits are no longer available.

Knowing as we do the sympathy or reciprocity which exists between the skin and mucous membrane, and how disturbance of one sheet or membrane is taken up by its compeer, we should expect that the stoppage of the cutaneous drains would be followed by a rush of perspiratory matters being determined to the mucous membrane. And further, that such matters would be discharged on the mucous surface in excess; also that other parts of that mucous sheet than those accustomed during health to such elaborating duties would take on the secretive process, and give rise to the transpiration or formation of those particular materials, Also that the presence of irritating fluids on such parts of the mucous membrane as were unaccustomed to them, would affect the welfare and comfort of the organ, and materially derange its natural functions. Such then are the practical effects of the E. and N.E. winds acting on the cutaneous surface.

150. But if it could be additionally demonstrated that there were copiously distributed in the sensitive

structure of the skin, nervous fibrillæ, endowed not only with the faculty of sensation, but with a power of exciting peculiar motor action, then we should attribute to such cutaneous disturbance a morbid realization of exalted sensibility and general motile excitement throughout the capillary portion of the circulation. To Dr. Marshall Hall we are indebted for these and other important facts in reference to the excito-motory nervous system.* Again, what more likely to add to this cutaneous excitement than an accumulation of noxious matter dammed up in these depurating channels?

151. Whatever irritative dyspepsia may ensue, it is clear that the disturbance is spread over the whole sheet of gastro-pulmonary mucous membrane. The frontal sinuses (behind or under the eye-brow, communicating with the nose); the conjunctivæ (an extension of the same mucous membrane up the nasal duct); the passages of the nose, mouth, fauces, and respiratory organs, are more likely to take on morbid action from their exposure to the morbific properties of these winds. The moist mucous cells are dried up by the absorbing powers of the E. and N.E. winds (§ 18, 19); their desquamation is expedited; their secretive powers are diminished, and fluid is dropsically collected under the epithelial structure. The natural calibre of the windpipe is thus diminished by the cushioning of the mucous membrane.

* The excito-motory action is demonstrated thus. If the skin of a frog's foot be tickled after decapitation a muscular movement is caused in the extremities; but if the skin of the foot be removed, no such effect is produced.

The stomach partakes in the general excitement and inundation; the pneumo-gastric nerves are highly irritated, and this irritation runs up the nervous cord to the lungs, heart, the larynx, and finally to the brain, where these most important nerves originate.

Irritative dyspepsia can in no way sufficiently account for these phenomena, when other organs betray a much greater amount of lesion; nor do sedatives succeed in allaying these maladies; no treatment, in short, is efficacious or successful, which does not entirely antagonize the lactic acid diathesis.

152. A person in health boldly defies these winds; but an individual previously indisposed, is rendered highly obnoxious to their influence. What is that predisposed state of system? My experience tells me it is the lactic acid diathesis.

These views have the disadvantage of being entirely novel: but all the facts on which I rely, the groundwork on which these doctrines are built, are supported by the testimony of the authorities I have quoted, and the concurrent evidence of many other writers.

TREATMENT.

153. I scarcely know how best to describe the medical and dietetic management of these cases—ever varying, as they do, in intensity and malevolence—without being too prolix and verbose. However, let the severest case be the type of the whole.

If I found the papering of my walls besmeared and

stained by any extraneous substance, it would clearly be my first object to operate upon, and render inert, those qualities which were most injurious to the fabric; and, secondly, to prevent the recurrence of the circumstance.

If I found an irritating acid mingled with the fluid lying on the mucous membrane, I should take steps to neutralize that acid, and render it innocuous. If I found the system also replete with it, I should follow up the administration of my antagonistic remedies, so as to chase and annihilate the aggressor. And if I found the channels for its natural efflux stopped up, I should take measures to re-open them. Whatever excitement it had caused, I should use means to allay, and should provide against its abnormal formation. I should add to these, the adoption of all known auxiliaries for the general promotion of health.

154. The treatment is simple, rational, and intelligible; indeed, a comprehension of what appears in the preceding pages, must be almost suggestive of the remedial measures to be adopted.

Lactic acid and soda are found in combination in the human system in great abundance, especially in the blood, (§ 199) which may almost be considered proclamatory of their natural alliance; and this would in itself create in one's mind a preference for that alcali (soda), over any others. Soda is itself a powerful irritant, or rather escharotic, and would, even much diluted, produce very injurious effects on the mucous membranes. The carbonate of soda, a drug of very great utility, yet inoffensive in its nature, is composed of one equivalent of

carbonic acid to one of soda. The bi-carbonate of soda, composed of two equivalents of carbonic acid to one of soda, is preferable, for the reasons, that it is much more soluble than the simple carbonate, and can be added to mercurial preparations, preventing their irritating the stomach, and not decomposing them ; (a good additional illustration of the effect of irritation in provoking acid secretion). Both carbonates readily release their own carbonic acid, to unite with almost any other known acid.*

155. Three circumstances indicate the administration of the alcali :—

1st. To neutralize all acid lying mingled with other fluids on the mucous surfaces.

2nd. To prevent the fermentation and conversion into lactic acid of farinaceous, and saccharine alimentary matters.

3rd. To correct the acid diathesis, and to check its excessive formation in the capillary circulation.

We will suppose a patient to be in that febrile state, arising from the first impingement of an East wind ; that the mucous membranes are all in a loaded and highly-excited condition. Secretion and absorption by the mucous membrane are alike interrupted by the dried state of the epithelial cells. Any one in such a state would refuse farinaceous food, which would assuredly turn acid, and would much prefer a draught of perfectly pure cold water. But if I add to this a few grains of

* It is of the deepest importance that the several drugs herein alluded to, should be of the purest possible character.

bi-carbonate of soda, the draught will become refreshing and cooling, "the viscid mucus, *slightly acidulated*, effervesces with the alcaline carbonate;" (§ 127.) the epithelial cells of the stomach are moistened; the endosmosis (absorption) of fluids from the stomach re-commences, and a free secretion of "viscid acidulated mucus" ensues. The mucous membrane of the tongue, the mouth, fauces and gullet, have derived the same benefit from the grateful fluid washing their shores. The larynx is relieved as well, by the inhalation of some of the alcaline fluid into the wind-pipe, also by its nervous connection and sympathy with the stomach, (§ 52 and 81), arising from that harmonious action which is peculiar to the skin and mucous membrane, the *whole* sheet assuming the physical condition of its *parts*. (§ 120.)

156. The tendency to recur to this dry condition is now on the decline, from the copious draughts of the alcaline drinks, and care must be taken that the quantity of alcali is not great, for if it exceeds the specific gravity of blood (1055,) absorption is opposed, and *exosmosis* of fluid takes place into the stomach, (this is one mode of action of some saline purgatives) and not from the stomach into the system. (§ 34). About 30 grains of bi-carbonate of soda to an ounce of distilled water, give a specific gravity of about 1055, but so powerful a drink would dissolve all the protecting mucus of the stomach, and cause excessive irritation. I prefer a solution of 40 to 60 grains of the bi-carbonate, in an imperial pint of weak gum arabic water, which shields

the stomach from the too rapid action of the alcali. If the tongue becomes white and pasty, the alcali should be suspended for a short time.

This having been accomplished, sago or tapioca, boiled in water, may be substituted for the gum water, and which may be cooled with a little milk, as we proceed, still holding the bi-carbonate in solution, which now may be lessened in quantity, or regulated according to the amount of fermentible matter (farina, sugar, and milk) consumed.

157. I need scarcely say, that when no pepsine is being secreted, the use of animal food is strictly contra-indicated; even milk must not be taken at first, nor subsequently, if it does not agree. Many persons, from their debility, fancy such a diet is starving, and that they want more *support*. Here is the bane!—the immense difficulty of keeping patients strictly to that diet which is proper for their welfare, but which they do not comprehend. These are the forms in which I would administer the alcali. When the acidity of the stomach is somewhat controlled, a cup of sago water, or tapioca water may be alternated, without the alcali in it, so as to relieve the "toujours perdrix." The diluted hydrocyanic (prussic) acid, will be found of immense service in allaying the high excitability of the mucous membranes. I give from a half to a whole minim of Scheele's acid, at intervals of 3 or 4 hours. I think this dose is usually large enough, though much larger doses are given, but they produce considerable depression. Sugar should be especially avoided, as

being only one leap from lactic acid. (§ 134). Whilst the bi-carbonate of soda is certainly the best remedy on the whole,—the bi-carbonate of potass agrees best with some constitutions, especially where a diuretic action is likewise desirable, or if there is a gouty tendency. But certainly the former alcali is preferable, when there is much nervous sensibility; and perhaps the potassa in chronic and less compliable states of the stomach. If the gastric irritability runs high, and there is vomiting, Dr. Golding Bird's suggestion may be found valuable in these cases, as well as in certain urinary deposits for which he intended it.* He directs 30 grains of the bi-carbonate with 5 grains of citric acid, (or a tea-spoonful of lemon juice) to be mixed in a tumbler of tepid water, followed freely by diluents. The acid property is perfectly annihilated, by the large excess of alcali in this agreeable and refreshing draught. The respective eligibility of the salts of soda and potassa, will be discussed in the next chapter.

158. Aperients often fail in their intended effects; but, strange to say, that the few first doses of bi-carbonate of soda will generally produce a most comfortable action of the bowels. This is much assisted by a cold or tepid lavement, consisting of a drachm of tartrate of soda, dissolved in 4 ounces of thin gum mucilage. Indeed, whether constipation or diarrhæa prevail, the alcali seems to possess a regulating and corrective power over them.

The difficulty of breathing and cough demand our

* On Urinary Deposits, p. 162.

most careful consideration. The patient inspires with great labour. Rhoncous sounds occasionally in the windpipe are audible, even in the adjoining apartment; and the cause of the suffocative embarrassment is most clearly evident in the windpipe. To the relief obtained by the alcaline drink, I add an external adjuvant. I apply a cold damped piece of flannel, with some moistened curd soap well rubbed into it, as a plaster round the throat, till it becomes well nettled, and then remove it. If this does not cause sufficient irritation, a little flour of mustard may be sprinkled over it; but in that case, it should not be applied over the site of the larynx or trachea.

These remedies act like a charm, and only require to be witnessed, to be convincing proofs of their efficacy. The soap cravat may be re-applied as often as the effects of the previous application fade away, or the upper part of the chest may be the seat of the next application.

159. We next turn our attention to the skin. No external application has greater power in renewing or promoting the healthy action of the skin than alcalies, of which soap is a good and valuable example if made of proper materials. I scarcely ever use my hot-air apparatus, or hot baths, for the purpose of renewing the action of the skin, unless in a most pressing case, on account of their enfeebling and depressing consequences.

Let a flannel be damped with tepid rain water, and well smeared with soap-lather. Let this be well rubbed over the body and limbs before going to a warm bed, in a warm room, and remove the soap, not by washing it

off, but by rubbing it away with a rough towel; put the patient into a warm bed and give him a draught of cold water, (§ 119). In the morning let him be well rubbed with a flannel glove, well floured with dry carbonate of soda before he leaves his bed.

160. As we proceed, a little boiled sole, turbot, rabbit, or chicken may be added to his diet, together with a head of cauliflower, broccoli, or well-boiled greens. The vegetable matter named is of immense service, being a cooling nutritious laxative, (§ 64). Let it be well remembered that the acid diathesis is not yet suppressed; *one error in diet*, and the whole may return! Tea, salt, and other irritants, acids, &c. have been fully alluded to, and their effects demonstrated in previous pages.

To these measures I would add, that a lozenge or bolus consisting of half a grain of extract of henbane with three or four grains of, each, powdered and extract of licquorice, and so made into a tolerably hard consistence, may be taken (previously slowly dissolved in the mouth) several times in the twenty-four hours, to relieve cough or restlessness; and if heat and dryness of the mucous membrane continue, a quarter of a grain of ipecacuan may be added.

161. The following aperient pills are of extreme utility in all cases of irritability of the system (especially for ladies); they are unexciting, give no discomfort, nor do they leave any debility.

Take of Compound extract of colocynth 24 grains.
Extract of henbane . 4 grains.
Ipecacuanha . . 1 or 2 grains.

Divide into 12 pills, and two may be taken for a dose at any hour.

Others may find the common seidlitz powders, taken twice or thrice a week, an agreeable and comfortable aperient; or an ounce of Dinneford's fluid magnesia, with or without a tea-spoonful of lemon juice.

The earliest and most agreeable tonic, or cordial that can be taken, is a wine-glassful of clove tea, and a few drops of compound tincture of cardamoms added when the tongue has lost its redness.*

I am aware that for the first day or two this strict discipline may be irksome; but even if so, it will assuredly be successful. The *slightest deviation* from a strict diet may be a source of entire failure. I have seen urgent difficulty of breathing, and cough come on immediately after tasting only a little of the weakest table-beer. I have observed repeatedly the same effect proceed from an orange, or acid lemon drops. Recollect what Dr. Beaumont says even of a basin of soup, (§ 132) consumed in such a condition of the stomach. Errors of diet unfortunately are screened under a most common question, "How can *so* and *so* hurt me?" The respondent being unable to detail the consequences, the verdict is appropriated by the patient in default.

* If the tone of the stomach be much diminished, the *mineral* acids (not the *vegetable*) may be advantageously, but cautiously, administered, with infusion of calumba or of orange-peel. Lime-water in milk is a valuable tonic in some cases.

162. I will here allude to a therapeutic agent of great service in many morbid states of the larynx and glottis, the application of solutions of nitrate of silver (lunar caustic) by means of a sponge probang. In ulcerations, follicular disease, &c. the application is of great value; but it is necessary that I should explain its operation in the disturbed state of the larynx arising and depending upon the lactic acid diathesis. The application of the solution once or so, is attended with marked comfort to the patient, who tells you he breathes more freely, and he is enabled to get up the viscid mucus rendered tenacious and insoluble by the acid secreted. But this relief is most transient, in the absence of medical and dietetic treatment; the first effect of the solution of caustic is to deaden temporarily the sensibility of the laryngeal nerves; but the quantity of it which remains on the gastro-pulmonary mucous membrane, and that which finds its way into the stomach, so fearfully excite the lactic acid diathesis, that after one or two applications, all benefit is lost, matters are made ten times worse than ever, and the disturbance is perpetuated as long as the remedy is applied. I have had large experience in the application of solution of nitrate of silver to the epiglottidean and laryngeal membranes, and am in my own person a living attestation of the truth of my remarks. For many months I drank nothing stronger than tea and coffee; I took acid fruit and lemonade freely, and had my throat repeatedly sponged with the caustic solution. The E. and N. E. winds caused me an oppression of

breathing, nearly suffocative. I followed the advice of my medical friends strictly, but without relief. I came at length to the determination of investigating the subject thoroughly. The result of my observations, experiments, and investigations, I now present to the public, confirmed and verified in every respect by three years' subsequent experience.

163. There is an opposite condition to that which I have noticed; a debilitated state of system accompanied by the excessive expectoration of saliva. Where vascular action is at a low ebb, and either as the result of old age or a prolonged illness, there is a general pallor of the cutaneous surface. In this state a stimulating alcali is given with great success, and we find that the sesquicarbonate of ammonia in two or three grain doses every four or five hours, produces the very best effects. The ammonio-citrate of iron may be given in similar doses immediately after a meal, if the vital powers are very low and feeble, and if it is not in any respect contra-indicated. Weak, and nearly saltless beef-tea, (so as not to oppose endosmosis (§ 34), but it may be spiced,) should be frequently given, also cocoa, milk, &c. which will form a most nutritious and unirritating diet, till the digestive powers will permit a gradually enlarged one. A warm aperient may be occasionally necessary, composed of 10 or 15 grains of rhubarb, and 2 or 3 grains of sesquicarbonate of ammonia, which may supersede a mid-day dose of the medicine. As the patient improves, a head of cauliflower, or brocoli, with a little chicken or mutton, will be an improv-

ing dietary. The henbane lozenges will here be serviceable also, and as an external application in suffocative respiration, or difficulty in expectoration, rubbing the whole chest and throat with brandy is highly serviceable.

I may here state that when the bowels take on excited action with diarrhæa, no medicine is so efficacious as the bi-carbonate of soda, with a few drops of compound tincture of camphor; and rice may then be chosen as the best farinaceous food.

164. Modifying these treatments according to the severity of the cases, keeping steadily in view the facts and principles herein laid down, together with the following remarks on the subject of food; I apprehend no one can have any doubt or difficulty in guiding the vessel safely between Scylla and Charydis, or steering clear of the shoals of East and North East Winds.

CHAPTER VII.

FOOD AND ITS USES.

165. I THINK the assertion will meet with general concurrence, that most human diseases arise from errors and indiscretions in diet. The ancient Romans, who lived on boiled barley, were strangers to our nervous and dyspeptic disorders; and those of the Scotch whose food is chiefly oatmeal, have but a limited category of disease: cerebral, liver, and urinary disorders are of rare occurrence among them.

It is particularly interesting to observe how the selection or nature of food modifies organic development. Two centuries ago, certain of the Irish were treated as rebels, and driven into mountainous tracts bordering on the sea. Brutalized and degraded by poor living, how physically distinct are they from their kindred race of Meath and other adjacent districts. Their low stature, not exceeding five feet two inches, "pot-stomachs," and bow-legs, projecting mouths, prominent teeth, and exposed gums, advanced cheek-bones, and depressed noses, exhibit conspicuous emblems of barbarism, typical of the earliest dawn of humanity and civilization.

We will now take an opposite picture; and the *bee-hive* affords a beautiful illustration. The majority of the community are *neuters*—females with generative organs undeveloped. The queen-bee is the only perfect one, and is the sole parent of the forthcoming progeny. If she dies, or is removed, the bees then select two or three from the neuter larvæ, enlarge their cells to "royal cells," by breaking down some of the walls of the contiguous chambers, and rebuild them on an enlarged scale, removing at the same time the grubs which these cells contained. A pungent, stimulating food is now prepared for the royal babe, and this grub becomes a future queen, endowed with procreative faculties similar to her predecessors.

166. Herbivorous, carnivorous, and other animals, are led to the adoption of their particular diets by an instinct guided by their special internal formation. Indeed Professor Owen has been able to identify, by established laws, some antediluvian beasts, and to arrange their geological fragments, as well as to determine to what class of food each was indubitably attached, though the habits of the animal were previously unknown to him.

Man's physical characters dedicate him to a mixed diet: and most lamentably ignorant are they who advocate his entire devotion to a vegetable diet.

But a meal composed of animal and vegetable matter in no way implies or demands a necessity for the condiments and liquors which our artificial mode of living has seduced us into.

It is by loading the stomach, and urging it to the

digestion of food which is oppressive to it, and exhaustive to its healthy action, that we voluntarily invoke disease, create unhealthy products of digestion, embarrass the system with poisonous materials, and lay the foundation of disease.

167. Food has been variously classified by different authorities.

Dr. Prout, taking milk for his type, divides food into four classes.

1 water, 2 albumen, 3 fat (cream), 4 sugar.

Liebig makes two classes only.

1 Plastic (or flesh-forming) food.*

2 Respiratory food.

Having examined in the two grand natural divisions, animal and vegetable, the plastic and respiratory materials found in each, we shall then proceed to the mineral kingdom, and acknowledge how much we are indebted to its stores, for our existence, welfare, and strength.

168. Mülder prophesied that all animal matter used as food (excepting fat) could be traced back to a certain composition as a *root*, from which all fleshy materials could take their starting point (as clarified sugar might be the root of all syrups and confectionery); and this conjectural substance, called by its founder *protein* (from πρωτευω, I hold the first place), has since been actually realized.† The three subsidiary classes of food

* Called also *nitrogenous*, from containing that principle,—*sanguineous*, by Dr. Gregory,—*calorifiant* by Dr. R. D. Thomson.

† " Fibrine, albumen, and caseine, (both animal and vegetable)

—fibrine, albumen, and caseine, were hence called the protein compounds. Lean meat, white of egg, and cheese, are familiar illustrations of these articles. To these I shall here add the analysis of gelatine, which is used very much as an article of diet.*

The three protein compounds, fibrine, albumen, and caseine, refresh, renew, repair, and build up, all parts of the human fabric, and are therefore rightly termed plastic (or creative) materials.

It may be asked, whence so great a physical distinction, in substances so chemically similar? Our chemical knowledge supplies us with similes. Otto of rose and our street gas are constituted alike, and are both members of that inflammable class of bodies denominated from their composition Hydro-carbons. Carbonate of ammonia (smelling salts) has the same components as moist atmospheric air. Sugar and saw-dust are similarly composed; tallow and butter.

dissolve in a solution of caustic potass. If to the resulting liquid acetic acid be added, the same precipitate is obtained, whichever of the above three principles has been employed. The substance thus precipitated is protein."—Pereira on Food and Diet, p. 39.

*	Carbon.	Hydrogen.	Nitrogen.	Oxygen.	Sulphur.	Phosphorus.
Protein.....	55.29	7.00	16.01	21.70	——	——
Albumen....	54.84	7.09	15.83	21.23	0.68	0.33
Fibrine.....	54.56	6.90	15.72	22.13	0.36	0.33
Casein.....	55.10	6.97	15.95	21.62	0.36	——
Gelatine....	50.048	6.477	18.350	25.125	——	——

Mulder's formulæ.—Todd and Bowman's Physiology, pp. 37—42.

ANIMAL FOOD.

1. *Plastic.*

169. Fibrinous food—The dried muscles of animals fully matured in age, deprived of nerves, fat, &c., contain 70 per cent. of fibrine.

Fibrine is chiefly found in beef, mutton, pork, venison, hare, duck, goose, &c., and in certain fish, as salmon.*

The darker meats, and those which have a tougher fibre, are generally fibrinous, and abound in ozmazome (a stimulating digestive agent), iron, and other exciting elements. "Thus beef and mutton are more purely fibrinous than veal and lamb; because in the two former and in most animals of mature age, the fibrine exists in larger quantities, in proportion to the albumen and gelatine (jelly), than they do in the two latter, and in young animals." †

Fibrine is the most stimulating of all animal food, and excites in a high degree the muscular and vascular action of the stomach.

It is the most nutritious, and leaves least residue. Hence it is *improper* for all persons suffering from irritable states of constitution and weak digestive powers. It is *proper* for persons using great muscular exertion, for persons of pale or lymphatic temperament, sluggish habits, residents in low situations, and all who require a healthy stimulus.

170. Albuminous food is found purest in the white

* Combe, op. cit. p. 138. † Combe, op. cit. p. 137.

of egg, which contains water 80. albumen 15. 5. uncoagulable matter 4. 5. in every 100 parts, and is always accompanied by free soda.

It is found in brains, liver, kidney, spleen, pancreas, sweetbread, (thymus gland), and indeed in all glands,* and particularly in the flesh of young animals ; in whey,† tripe, yolk of egg, (in combination with oil, phosphorus, sulphur, &c.) ; in oysters, haddock, turbot, soles, fresh water fish, &c.

Albumen cooked by *a small degree of heat*,‡ for it is coagulated at 167^0, is easily digestible, very nutritious, and much less stimulating than fibrinous meats.

There is no ozmazome in the flesh of young animals, and it is deficient in iron.

As fibrine chiefly repairs and supplies muscular tissue, the albuminous class of food is *improper* for labourers and pale persons, (who are deficient in iron). It is *proper* for the sedentary and indolent, for nervous, excitable, bilious, and sanguine temperaments, for convalescents and sufferers from irritable and exciting disorders.

Albumen may be considered the grand staple of life.

* Liebig's Letters, &c. p. 346.

† When *whey* is used as diet, it should be re-alcalized by the addition of Carbonate of Soda.

‡ Sportsmen eat hard boiled eggs, as being less easily digestible, and therefore as they believe "more sustaining." "Coagulated albumen is readily soluble in alcaline solutions; and when an excess of alcali is present, no coagulum takes place on boiling."—Bowman's Medical Chemistry, p. 43. This indicates the use of alcalies with albuminous food.—C. B. G.

"In the egg, by warmth and oxygen, which has access through the shell; under the influence, therefore, of those conditions which accompany respiration, all the parts of the body, feathers, claws, muscles, membranes, cells, blood, nerves, bones, &c., are developed. It is obvious, therefore, that *albumen* is the starting-point and foundation of the whole series of tissues, which constitute those organs, which are the seat of vital action. The elements of these organs now possessing form and vitality, were originally elements of albumen."*

171. Caseine is an ingredient in milk, (rendered soluble by the presence of free soda) which, deprived of its water, contains caseine 34 parts in 117 of milk.

By the addition of a weak acid, or a ferment, as rennet (§ 134), the sugar of milk is converted into lactic acid, and the fermentation, once set in motion, runs through any quantity of milk, its caseine acting as the nitrogenized substance "under change," (§ 134) rapidly rendering all the caseine insoluble (curd).

The composition of cheese is nutritious; being one of the three protein compounds, and seems highly adapted for infantile nutriment. It is the only protein compound which contains no phosphorus, (see Note to § 168).

In its soluble state (in milk) being held in solution by a free alcali, caseine is readily digested, (if its albumen is not coagulated by heat in cooking) even in very feeble conditions of the stomach, provided it meets with

* Liebig's Letters, p. 345.

no acid in that organ, as in the lactic acid diathesis, when it becomes curdled, and then is most irritating.

The insolubility of cheese is confirmed by the acids it encounters in the stomach ; its digestion is, therefore, extremely slow, and its effects irritating. Hence the gourmand (§ 58), takes cheese as one of the stimulants of his repast.

172. As the three plastic (protein) articles rely on the presence of a free alcali in the system for their solubility, it must occur that in excessively acid states of the stomach they cannot be digested, (§ 56), nor can the bile and pancreatic juice restore their alcalinity. (§ 65). I may here observe, that fibrine is soluble only in the living circulation ; for immediately that it leaves the vital current, as in cuts, or ulcers, and in bleeding, its rapid coagulation takes place, which is often a property most conducive to our interests and welfare. Their coagulability may thus be tabulated :—

FIBRINE.	ALBUMEN.	CASEINE.
Coagulates spontaneously, not by heat nor acids.	By heat and acids, not spontaneously.	By acids, not by heat, nor spontaneously.
Coagulates in organic threads.	Coagulate with no definite structure.	

That fibrine and albumen are mutually convertible, is shown by the following experiments. If we leave muscular tissue covered with water, and exposed to the air a very short time, a part runs into decomposition and the whole becomes soluble and liquid. If heated, this proves identical with albumen. The conversion of ca-

seine into its two confrères is shown in the above quotation (§ 171) relating to childhood.

173. GELATINE, vernacularly termed jelly, takes no nutritive rank. It is not convertible by any practical or theoretical means into either of the protein compounds, nor does it possess sulphur or phosphorus.

Dr. Pereira says,* "Gelatine is incapable of conversion into blood, but it may perhaps serve for the nutrition of the gelatinous tissues (cellular tissue, membrane, and cartilage)."

Liebig observes,† "It has now been proved by the most convincing experiments, that gelatine has no nutritious value—is not capable of supporting life—but it overloads the blood with nitrogenous products, the presence of which disturbs and impedes the organic processes."

Dr. Carpenter remarks,‡ "The presumption derived from various experiments is, that gelatine cannot be applied to the nutrition of muscular and other fibrous tissues."

All authors § seem to agree that its nutritious properties are of a very insignificant character; but that it has the advantage of being a ready-made material for the sustenance of the gelatinous structures.

Gelatine is readily soluble at a very moderate tempe-

* Treatise on Food and Diet, p. 43.

† Op. cit. p. 425.

‡ Manual of Physiology, § 429.

§ Douné; Magendie; the French Academicians, &c.

rature, and when diluted with 100 times its weight of water, makes when cold a consistent solid.

Its solubility, its transparency, and disregard of acid or alcaline adjuncts,—its massive and beautiful appearance, especially with colouring matters, has created for it a value which it does not alimentarily deserve. When pure and thin it is readily absorbed by the veins of the stomach, and excites probably little or no digestive action. These attributes confer on it some practical utility for invalids when the digestive organs are feeble, as it slightly employs the secretive functions of the stomach, is an admirable vehicle for wine and other ingredients, and relieves the pressing demands of that organ by its bulk (§ 53).

In its denser form it is slow of digestion, innutritious. and creates so little digestive action that without wine, acid, spices, and other stimulants to rouse the gastric energies to effect their digestion, they linger in the stomach, become rancid, acid, and often cause diarrhæa or vomiting. An instance has been recorded of apoplexy arising from eating cow-heel; and I knew one such instance from a corpulent gentleman eating a fried sole, the under skin (gelatine) not having been previously removed, which cooks scarcely ever think of. Indeed it is probable that the death of Henry the First arose from eating Lampreys with their skins on. The only real objection to the use of gelatinous food by healthy persons is, that it displaces better materials.

Gelatine is found in the cellular sheaths of muscular fibres, in skin (glue), in ligaments, tendons, membranes, and bones.

174. Albumen and Gelatine so much abound in a combined form as to demand additional notice. They are observable especially in veal and other pies, and abound in most animals in which there is a deficiency of red colouring matter.

The previous remarks would have suggested to a strong healthy person the addition of a more stimulating food in the form of fibrinous meats; and we find rump-steak, ham and tongue, with an abundance of pepper, used to improve their exciting and muscle-making properties.

175. From what has already been stated, we shall arrive clearly at the following conclusions.

1. That the three plastic (protein) compounds chemically resemble each other.
2. That their physical characters are distinct, and their action, as articles of diet, various—whilst they are mutually convertible.
3. That fibrine builds up muscular and other parts of the body, whilst albumen and caseine contribute mainly to the purposes of general nutrition.
4. That under the continual privation of fibrine, albumen acts in its stead.

ANIMAL FOOD.

2. *Respiratory.*

176. Fat (Oil, &c.) constitutes the whole of the material, destined for the purpose of respiration, contributed by animals.

It is composed (by measure) of carbon 13, hydrogen 11, oxygen 1. By the addition of 10 measures of oxygen and the removal of 1 of carbon, we have the precise composition of cane sugar: (Carbon 12, hydrogen 11, oxygen 11:) and it so happens that if more farina, sugar, or fat is devoured than is required for the purposes of combustion in the body,—if more *respiratory* matter in short is taken into the system than is used for those purposes, the superabundance is stored up in the body as fat, an excess of which may be said to constitute disease,* we have illustration in the bloated obesity of great ale drinkers. But this is one of our chief objects in the administration of cod-liver-oil, and points to the free use of butter and fat in cases where it is so indicated. Fat people bear privation of food (as corroborated by Arctic Travellers) infinitely better and longer than spare ones, and are less affected by external cold. The accumulation of fat is much promoted by warmth and indolence (§ 100): facts that demand strict attention in attenuating diseases and impoverished constitutions. Many persons who are said to be "bilious" have actually a deficiency of bile secreted; fat must then be used most sparingly, as it cannot be saponified in the duodenum (§ 65), and passes through the intestines unchanged, and often becomes a source of irritation. But if the excretions and vomitings evidence the excessive secretions of bile, a better antagonist cannot be found than fat bacon for breakfast, as recommended by Dr. Bailey. Plastic food does not form fat;—great eaters

* Lord Byron terms it "oily dropsy."—Rejected Addresses.

of it are usually thin, but of firm muscular fibre; a fact noticed to advantage by pugilistic and pedestrian trainers: and it is eaten underdone, so as to contain all its albuminous and mineral constituents undisturbed. A person who takes a glass of beer before running, is out of breath in an instant; and spirit (hydro-carbon) drinkers are no better off; for the system, in either case, is flooded with hydrogen and carbon. Oil-cake fattens cattle; and the unfortunate geese at Strasburg, whose feet are nailed to the ground, to deprive them of motion, are stuffed with respiratory materials, and kept in a room heated to a very high temperature, have fatty disease of their livers, which furnish the esteemed luxuries, *Pâtés de Foies gras*. Oil-merchants who repeatedly taste the oils they purchase, often become immensely fat.

177. Fat undergoes no change in the stomach, and is therefore highly improper for irritable states of that organ. So much of that material as passes the duodenum unassimilated (not saponified) travels onward through the bowels, and acts as a mild laxative and lubricant.

Fat (embracing suet, butter, oil, &c.), embodied with articles of diet, impedes their solubility, and therefore digestibility. Hence pancakes, and fish fried in oil, suet-dumplings and rich pastry, oily meats, as fat pork and liver,—oily fish, as salmon, eels, &c., are difficult of digestion, in the conditions of the digestive organs which I have described. Mr. Dickens, aware of such occasional disagreement, puts these memorable words into

the mouth of the inebriated Pickwick, when discovered floundering in the mud, and charged with being intoxicated, he declares, "It was the salmon did it." Fat has its representative (cream) in milk, which tells us, by its silent admonition, how useful fresh butter is in the dietary of children.

VEGETABLE FOOD.

178. The vegetable kingdom holds a position of the deepest interest; it not only exclusively supplies aliment to a large class of the animal creation, but it is the intermediating agent between the animal and mineral domains. Vegetables select from the earth and elaborate all those mineral substances, on which, as will shortly appear, our organization and existence depend. To the maritime dominions (and salt mines) we chiefly appeal for our soda; to the terrestrial vegetation, for potass; for our earths and metals, we explore the fossil regions, —all with immense cost and labour: but there stand a few insignificant plants, who, perfectly stationary, draw from the mineral fields all those articles which our nutrition demands, and which confer on them accordingly their respective alimentary value. Animals who feed on vegetable matter are valueless to us, if their flesh does not possess the necessary quantity of minerals.

179. Vegetables also present to us plastic materials, differing in no respect from those which we obtain from the animal kingdom! And as though to taunt us with

our voluntary indolence, in comparison with their rooted activity, one plant (the sensitive) imitates our muscular action, whilst another actually decoys and devours insects in our presence! *

180. *Vegetable Fibrine,*

Is readily and abundantly obtained from wheat-flour, by washing away the starch with cold water, and drying the residue, which is called *gluten*.

By allowing the expressed juice of vegetables to stand, a jelly-like precipitate soon separates and sinks. The colouring-matter being removed, a grayish-white substance is left,—this is *vegetable fibrine*.

181. *Vegetable Albumen,*

Remains dissolved in the juice mentioned above, after the separation of the fibrine. At a temp. of 167^0, it is coagulated, and may be collected.

When the clarified juice of nutritious vegetables, such as turnips, cauliflower, or asparagus, is made to boil, a coagulum is formed, which cannot be distinguished from that of white of eggs boiled in water.

182. *Vegetable Caseine,*

Is chiefly found in the seeds of peas, beans, and si-

* In the Sarracenia and Dischidia (pitcher plants), according to Mr. Burnett, the modifications of leaves called *pitchers*, attract insects by their fluid, and prevent their escape by the long bristles which line the cavity. The fluid dissolves the bodies of the insects, and the whole is absorbed into the plant.

milar leguminous seeds. It may be extracted from their *meal* by cold water, and kept in solution, on the surface of which, when evaporated, a skin forms, and the addition of an acid causes a coagulum just as in animal milk.*

The almond emulsion has *all* the characters of milk.

183. *Vegetable Gelatine,*

Exists in Ceylon-moss, to the amount of 54 per cent., with 15 of true starch. "By boiling in water, it yields a liquid which gelatinizes on cooling. The decoction or jelly forms an agreeable light article of food for invalids or children."†

It is satisfactorily proved, 1st, that the protein (plastic) substances, derived from the vegetable kingdom, when properly purified, differ in no respect from those obtained from vegetables. 2nd, that the protein compounds, animal and vegetable, alone are capable of conversion into blood, and of forming organized tissues.‡

184. We can now comprehend what is meant by the plastic matter furnished by vegetables. Liebig has given us a most valuable table of the relative average

* Mr. J. Itier says, "The Chinese make a *real cheese* from peas by boiling them to a thin paste, which is passed through a sieve and coagulated by a solution of gypsum. The curd, acted on by rennet, is pressed, and with the addition of salt formed into a *cheese.* It is sold in Canton under the name of Taofoo, and cannot be told from *milk cheese.*"

† Pereira on food. p. 391.

‡ Pereira, op. cit. p. 42.

amount of plastic and respiratory materials contained in the following articles of food.*

	Plastic.	Respiratory as starch.
Cow's milk contains	10 parts to	30
Human milk „	10 „	40
Lean beef „	10 „	17 equal to 7 of fat.
Lentils „	10 „	21
Horse beans „	10 „	22
Peas „	10 „	23
Wheat flour „	10 „	46
Oatmeal „	10 „	50
Rye flour „	10 „	57
Barley „	10 „	57
Potatoes, white „	10 „	86
„ blue „	10 „	115
Rice „	10 „	123
Buckwheat flour „	10 „	130

As 10 parts of fat correspond to 24 of starch, it is easy to calculate its equivalent. Peas, for instance, contain a substance nearly equal in respiratory value, to 10 parts of fat to every ten of plastic food, making its soup a very eligible article for the poor in winter. Wheat-flour, it may be seen, is nearest allied in constituents to human milk, which is the perfect formula of human diet. 17 parts of lean beef contain as much plastic matter as 33 parts of peas, 56 of wheat-flour, 67 of rye-flour, 96 of white potatoes, or 133 of rice.

* Letters on Chemistry, p. 361.

	Plastic.	Respiratory as starch.	Equivalent as fat.
185. Fat pork contains	10 parts	to 30	equal to 12.5
Fat mutton	„ 10	„ 27	„ 11.25
Lean beef	„ 10	„ 17	„ 7.08
Hare	„ 10	„ 2	„ 0.83
Veal	„ 10	„ 1	„ 0.41

It is obvious, that by a due mixture of these articles of food, we can obtain a diet of a composition analogous to that of milk or wheaten bread. By the addition of bacon or fat pork to peas, beans, or lentils; of beef to potatoes; of fat bacon or ham to veal; of mutton to rice, we entirely regulate our diet, and may, in each instance, make it accord with the prescription of nature, as made manifest in milk. A horse fed on meadow-hay only, may become fat, but he requires for severe muscular exertion the plastic matter of corn. An indolent man is best dieted on respiratory food—a labourer on plastic. If the former takes more plastic food than his muscular expenditure in exercise requires, the redundancy charges his system with lithic acid, urea, and other nitrogenous matters; the lithic acid diathesis is created, and gout, local pains, and organic disturbances are the result. I can trace back many cases of great suffering, in which my efforts were baffled by the impossibility of sailing to nature's compass. "You may physic me as you please—I will swallow bottles and all, if you wish it; but I wont give up my diet. Surely I know best what suits me." This is the language we are often accustomed to have addressed to us.

My excellent friend, Sir James Eyre, has made some very amusing remarks on this subject.*

186. Cow's milk contains less respiratory matter than human; therefore a child deprived of its parental support, should have the cow's milk sweetened with sugar. A child fed on wheat-flour boiled in water, should have cow's milk added, to comply with the proportions of its natural sustenance. The composition of farinaceous and saccharine matter has been previously detailed; and it is a curious circumstance, that the privation of oxygen in the system leads to an excess of three important substances: sugar and farina into fat; carbonic acid and water into lactic acid; and urea into lithic acid,—all being sources of distress to the system, when in abnormal abundance.

It is a truth worthy of being here recorded, that man and carnivora cannot digest raw farinaceous matter: a fact worth remembering by those who eat the wheat which they pillage and devour by handfuls in their walks through the farmer's corn-fields.†

187. I have constructed a table, shewing the quantity of plastic matter per cent. of various articles, and with these statements before us we are competent to regulate the dietaries of any classes of individuals.

* "The stomach and its difficulties," by Sir James Eyre, M. D.

† This explains the indigestibility of nuts, &c., and why they are said to be injurious for coughs.

		Plastic food per cent.
Wheat flour	contains	10 to 35
Dried Peas	,,	29
Bean Meal	,,	25
Green Peas	,,	24
Linseed Meal	,,	23½
Lentils & Harricots	,,	22
Scotch Outmeal	,,	15½
Barley	,,	11
Malt	,,	8½
Rice	,,	8
Sago	,,	3.33
Arrow-root	,,	3.21
Tapioca	,,	3.13
Potatoes	,,	2½
Cabbages	,,	2½
Parsnips	,,	2.1
Beetroots	,,	2
Turnips	,,	1½
Carrots	,,	1½

By comparing these tables, the quantities and proportions of the plastic and the respiratory ingredients in the various articles can be readily determined.

188. As the arrow-root and farinaceous foods of the shops are composed chiefly of cheap potato starch (containing not an atom of plastic or mineral material) we observe the delusiveness of trusting our children's health to such a wretched diet.

It is only necessary to repeat what has been stated in the chapter on digestion, that the plastic matter is

separated in the stomach to be acted on by the gastric juice; that farinaceous (and oily) matters are digested in the duodenum,—whilst the ligneous (woody) fibre follows the route of the bowels, undergoing little further change or digestion. When we wish to keep the stomach at rest, we avoid plastic food;—when acidity exists, we give weak farinaceous food, *protected* by alcalies; and when we wish for aperient action, we give well-boiled vegetables containing much woody fibre; uncooked vegetables (celery, cresses, &c.) are equally efficacious in strong and healthy stomachs only, and then their chilling effects should be warded off with spices, or digestion may be arrested, and apoplectic or epileptic seizures may follow.

189. Most fruits and vegetables contain organic acids,—the malates, the citrates, tartrates, &c., all containing the same elements as sugar, farina, and lactic acid,* namely, carbon, hydrogen, and oxygen. Their acid enters the blood in combination chiefly with potass, and is actually burnt in the system. The alcali allies itself to the carbon and oxygen only, and the article voided from the system is the carbonate of the alcali. In the higher forms of fever, these are the only means of administering respiratory matter to compensate the immense expenditure of substances undergoing combustion, also of importing an alcali to give solubility to lithic and other acids. So that the juice of fruits and some vegetables, well diluted so as to be speedily absorbed, effect three special objects,—diluting the blood,—furnishing respi-

* Garden rhubarb and sorrel contain oxalic acid.

ratory matter, and a solvent for the lithic acid generated by the rapid disorganization of the burning tissues. Sugar is likewise absorbed by the gastic veins (§ 62); hence currant and apple jellies plentifully diluted, are most refreshing and salutary beverages, and may be added to flavour the farinaceous water. These advantages obtain in high fevers,—not so when the lactic acid condition prevails, for that acid is as consumable as the vegetable acids above mentioned—but *acids are then in excess* in the system, and are consumed. Therefore by a renewed administration of vegetable acids they enter the blood to contribute in themselves to the formation of more lactic acid. This is not the case with mineral acids which have not that effect on the constitution. These vegetable acids combined with alcalies (and called salts) are usually found as—

Malates, in all kernel (pips) fruits and pine-apple;

Citrates, in stone fruits, currants, and potatoes;

Tartrates, in grapes.

Also in the juices of edible roots, tubers, and green vegetables.

The above are the reasons why vegetable matters are considered cooling, laxative, and "purifiers of the blood." Fruits contain also a considerable quantity of albumen, as cooks discover in the scum or skimmings, when making preserves.

190. I need scarcely add anything more as regards the effects of cold salads, melons, cucumbers, &c. on irritable and feeble stomachs; they are not only in such cases very indigestible, but may also produce such a

chill as may arrest digestion, and cause a reversion on the circulation of the brain. Acid or unripe fruits are also to be deprecated, especially for children. Boiled beet-roots eaten at breakfast are of great laxative and nutritious value, if there is no excess of acid in the stomach, which converts their sugar into lactic acid. There is a Spanish proverb, that ripe fruit is "gold in the morning, silver at noon, but lead at night," and the principles of dietation fully substantiate its truth.

The utility of farina as an article of diet has already been discussed; and it is a remarkable fact that a sportsman who fills his pocket with biscuit and consumes it during his labours, can go through an immense amount of work without much fatigue; and further, that he who stands in a shower and devours biscuits, rarely catches cold, on account of its supply of combustible ingredients.

191. I shall now proceed to refer more minutely to the physiology of farinaceous matter. I have pointed out that vegetables are intermediate between the animal and mineral worlds, and elaborate from the earth considerable magazines of inorganic (mineral) materials. The elements of their growth are derived from carbonic acid, ammonia, and water, which animals are constantly restoring again to the inorganic world, in precisely their original forms. The tree and man truly spring from a similar germ!

192. If we go back to the lowest state of vegetable creation; we find it simply composed of *cells*. The *red-snow*, and *gory dew*, parasite residents on the vast tracks of snow in the arctic regions, and which afford

meagre diet to the rein-deer, are strictly *cells*, and have no sustenance derivable from the earth. Cereal seeds are magnified illustrations of the same. Take a linseed for instance, it has an albuminous cortical covering (its husk or shell). If this seed is thrown into hot water, it very slowly delivers up its mucilage, however much it may be boiled; and what is true of the seed is true also of its minute fragments. The true farina of seeds is contained in very minute flattened cells like two watch-glasses placed edge to edge, and these cell-walls are composed of glucose (plastic matter) lined with albumen. If the meal of seeds is thrown into boiling water, the albumen of the cell-walls is coagulated, and its true farina is retained till the cell-walls are dissolved or decomposed; but if such flour is placed in cold water, it swells; the cell-structure bursts, and the soluble materials are taken up by the water. Heat may then be gradually applied, and the whole becomes dissolved.

If we desire to dissolve peas, (as in soup) pearl-barley, rice, coffee, cocoa, arrowroot, oatmeal, &c. we should first macerate them in cold water, and after some time place them on the fire to complete the solution of their plastic and farinaceous substances. If we desire to have peas-pudding, or rice-pudding, or other seeds placed on the table *whole*, they should be plunged into water at a temperature *exceeding* 176^0 (the temperature at which albumen congulates). If the ingredients contain oil, as cocoa and coffee, the temperature should not be very much higher, or the oil will be vaporized. Laundresses dissolve their starch in cold water before

submitting it to heat, on true philosophical principles; and it is really wonderful that instinct and blind practice are constantly anticipating the verifications of science! The potatoe contains its fecula (watery starch) in chambers made up of hexagonal plates. If when half boiled, they are suddenly removed from the boiling pot and plunged into cold water, the cell-walls contract and force out the water. If then returned to the boiling water, the cells expand, and a floury or mealy potatoe is your reward.

MINERAL ARTICLES OF FOOD.*

193. We have so far travelled through the luxurious fields of animal and vegetable diet. It now remains for us to explore regions so secluded from popular observation as never perhaps to have enjoyed the slightest notice in convivial balad, or in the pastoral strains poured forth by lyric shepherds. Who ever dreams that the French academicians made vast experiments on the subject, and determined that no article of diet is nutritious, digestible, or can support respiration, which is deprived of a due proportion of mineral materials? They proved that "animals fed on food from which all inorganic substances had been removed, died of starvation." Hence the aphorism, that "no animal can live on any one article of diet."

194. The blood on being submitted to great heat

* Called also *inorganic*, or *incombustible*, as they are left in the ashes after the blood or body is consumed by heat.

leaves *ashes*, which give evidence that the incombustible or mineral ingredients of blood consist chiefly of

Free phosphoric acid.
Alcalies { Phosphate of soda.
Phosphate of potass.
Alcaline earths { Phosphate of lime.
Phosphate of magnesia.
Oxidized iron.*
Common salt (chloride of sodium.)

and that these matters which never fail to exist in the blood of man, are found in the fodder of animals. These substances (called salts) exist in the blood in such proportions as to give it an alcaline ascendancy.

A predominating free alcali in the blood

1. Keeps the chief constituents of the blood in a *fluid* state.
2. Prevents the sanguineous fluid leaving the minute capillaries (§ 33 exosmosis).
3. Protects the albumen of the blood from coagulation, and renders a high temperature necessary for the purpose.
4. Dissolves oxide of iron (chief coloring matter), and gives it transparent solution.
5. It increases and promotes the combustibility of respiratory matter, and performs many other duties in respiration and secretion.

The reason must now be obvious why the acid furnished by the gastric juice in digestion (§ 66) should

* Oxide of iron forms twenty per cent. of the whole ash after deducting common salt.

be alcalized, as it is converted into chyle in the duodenum by the pancreatic juice and bile, so that the lacteal fluid should enter the circulation chemically suited by a preponderance of alcali for its new duties. For *sanguification*, *heat-making*, and *secretion* are undoubtedly carried on, only under the influence of an alcali.

195. Another property of the alcalies in the blood, is, that by their influence all the combustible matters are burnt in the system. The tartaric, malic, and citric acids, alluded to (§ 189), as existing in fruit and vegetables, are severally composed of carbon, hydrogen, and oxygen, in which state they enter the blood. The acid is burnt in the system, and its carbonic acid unites with the alcali, *displacing* a portion of the phosphoric acid of the phosphates. No such decomposition could possibly take place but with the aid of the alcali. But if lactic acid prevails in the system, and the alcali is oppressively encumbered by it, this decomposition of organic (vegetable) acids is impeded or thwarted, and possibly they may, themselves being similarly constituted, lend a hand to further acidulous formation. "In precisely the same way is lithic acid destroyed or burnt in the system." *

196. A most remarkable fact remains to be noticed. The phosphoric acid and phosphates mentioned in the above table, as constituting ingredients in the blood, owe their existence to the presence of these articles in the food. But by a change of diet we can exchange carbonic acid for phosphoric acid, and carbonates for

* Liebig's Letters, p. 399.

phosphates, without the slightest interference with the qualities or duties of the blood. When the food consists of bread or flesh, which leave in their ashes no carbonates, but only phosphates, the blood contains phosphates only. If we *add* to the bread and flesh, potatoes or green vegetables, the blood acquires a certain amount of alcaline carbonate. If we *replace* the flesh and bread entirely by fruit, roots, or green vegetables, the blood becomes entirely carbonated, and acquires the composition and quality of an ox or a sheep.

Whatever therefore the animals may be, whether carnivorous, herbivorous, graminivorous, or mixed, they all exhibit in the burnt ashes of their blood the *very same inorganic substances* which are afforded by the articles of their respective diets; the free acid, the alcalies, and alcaline earths being phosphates or carbonates accordingly.

Although this interchange of acids has no apparent influence on nutrition, sanguification, or the production of heat, yet the *secretions* are much affected by the change. Liebig says, "contrary to all known laws, it appears to the chemist like a miracle, that two acids, a gaseous and a fixed one—one of the weakest and one of the strongest—two, of all acids, which differ most in composition, can form with the alcalies found in the blood, compounds of the same chemical character." *

197. The alcaline carbonates take up a considerable portion of free carbonic acid, and hold it in their solutions, whilst the alcaline phosphates confer great solu-

* Liebig's Letters, p. 390.

bility on free phosphoric acid. We now can see in what manner carbonic acid after combustion enters the blood and is carried away to be exhaled in the lungs, and free phosphoric acid to join other materials which render it soluble and capable of reaching its natural outlet. Phosphoric and carbonic acids having but a slender affinity for their alcalies, readily resign their connexion to others, and thus aid in completing other decompositions. The products arising from these changes are removed from the body by three outlets, so as not to embarass the system. The gaseous by the lungs, the soluble by the kidneys, and the insoluble by the bowels. The table (§ 113) gives some idea of the importance of these proceedings. As no minerals are stored up in the system, and as the receipt must therefore be equal to the loss, how important it is to ascertain that the fluid, &c. excreted from the system, contain not only the sum of materials necessary to be discharged, but that they are elaborated in their *healthy* forms, and not in those various conditions, which not only announce with clearness and precision where lies the disturbance, but teach the physician how by *suitable diet* and remedial measures to reach and adjust the causes of disease, Gout, and *most chronic disorders*, must fly before a proper comprehension of such matters. I must confess, and deeply regret to say, that *dietation* is fearfully neglected in our profession, and grossly misused by the public.

198. The solid, insoluble organized tissues differ from the blood, in possessing free phosphoric acid, which

holds fibrine in solution, and has a special duty to perform in the formative or plastic process, which can be performed by *no other acid.*

The brain and nerves contain 20 per cent. of phosphorized fat. The vertebral bones half their weight of phosphate of lime and magnesia. The white of eggs contains an excess of alcali,—the yolk contains free phosphoric acid! It is clear, from these and other facts, that free phosphoric acid presides over and enters into the formation of the organized tissues.

199. Chlorine and sodium united, form common salt, which is not so deadly an enemy as has been represented by some advertiser.

There is no fluid of the animal body in which chlorine is absent. It is found in the muscles combined with potassium,—in the blood combined with sodium. "Whilst chlorine and potassium prevail in muscles, chlorine and sodium are essential and constant ingredients of the blood."—(Liebig.)

Potass residing in the muscular system in which plastic matter is decomposing, uses its solvent power to depurate the lithic acid matters (§ 145). Soda pervading the blood encounters the products of respiratory decomposition. These circumstances seem to ratify the eligibility of potass for the treatment of lithic acid in excess, and of *soda* for that of *lactic acid.*

Vegetables furnish but little salt or soda, hence our potatoes and amylaceous food suggest salt as a part of our diet. In North America large magazines of salt are provided for wild animals, called "buffalo licks."

All cattle-dealers know the value of salt on the meat, and even coats, of their animals. In many countries where it is very scarce (as in Africa), men are sold for salt—indeed only the rich can procure it. Mungo Park says, that among the Mandingoes, the expression—"he flavours his food with salt," is synonymous with being a rich man.

The intended limits of this Book compel me to curtail the subject before us, which I have dealt with, I fear, too briefly to be satisfactory, and very inefficiently. I shall now claim attention to a very few special *articles of diet*.

SOUPS

200. Are solutions of animal substances in water. During digestion, the water is absorbed, and the plastic matter left for the action of the gastric juice. Their albuminous and gelatinous solutions, of less specific gravity than the blood (§ 62), are taken up freely by the veins of the stomach; but rich fibrinous solutions (as beef tea), not only delay digestion, by requiring its water to be first absorbed, but it dilutes the gastric juice, and excites, to a very trifling extent only the peristaltic movements of the stomach (§ 61). "Soups do not call into play the muscular coat of the stomach, and are so slow of digestion, when that organ is already weakened, as to give rise to *acidity*. Hence they are unfit for most dyspeptic patients." * Chicken-tea, beef-tea, and soups,

* Combe, op. cit. p. 126.

during recovery from illness, ought always to be made very weak at first, and to be given in small quantities." *

As *fats and oils* resist the action of the gastric juice (§ 62), they should be carefully removed, by skimming or blotting-paper, for invalids.

Vegetable and *farinaceous* matter, mixed up in soups, have to be separated in the stomach from the plastic, and thus give additional labour to that organ.

Fibrinous soups (as beef-tea, &c.), derive their flavour from the *ozmazome* (§ 169), and contain also *iron* in solution, which renders them inadmissible in irritable or acid states of the stomach. Salt opposes endosmosis. (§ 34.)

MILK.

201. Contains plastic matter, sugar, butter, iron, lime, free soda, phosphates, &c. The specific gravity of cow's milk is about 1.030. It is adulterated with brains and albuminous matters, in order to hold in solution, chalk and turmeric, with a liberal addition of water.

Human milk contains most respiratory food,—cow's most plastic matter,—ass's milk is most easy of digestion.

The constituents of these three kinds of milk are shewn in the following table.†

* Combe, p. 56.

† Pereira on Diet, p. 249.

	Human	Cow's	Ass's
Caseine (plastic)	1.52	4.48	1.82
Butter	3.55	3.13	0.11
Sugar of Milk *	6.50	4.77	6.08
Various Salts	0.45	0.60	0.34
Water	87.98	87.02	91.65
	100.00	100.00	100.00

Heat renders milk easily acidulated, and when 'burnt" is partially decomposed. Hence for invalids and children, milk should never reach the fire, but be warmed by the addition of boiling water, or by plunging the vessel containing it into hot water.

BREAD.

202. Consists of moistened wheat flour, rendered spongy by its gluten holding the air bubbles arising from the yeast † in small chambers. It contains every sort of aliment with iron and other minerals.

White Bread consists chiefly of pure farina deprived of the bran,—which contains an abundance of service-

* "The milk of purely carnivorous animals is destitute of sugar, consisting, like their food, of protein compounds and fatty matter only."—Carpenter, op. cit. § 436.

† "Yeast changes a part of the farina into sugar and the sugar into alcohol and carbonic acid as in brewing."—The Chemistry of Common Life, by Prof. Johnston, Vol. i. p. 97.

able materials, especially bone earth (phosphate of lime) hence it is not fit nutriment for young persons, (children).

The great preference for white bread, leads the baker to the liberal use of *alum*,—from twenty-four to sixty-six grains in a quartern loaf. Thus an inferior flour makes a very white, elastic, firm, and dry loaf; and from the property possessed by alum of absorbing and retaining water, a much smaller amount of flour is necessary to make up the full weight of the loaf, alum is a powerful astringent, therefore pale colored jalap is used to obviate its constipatory effects. In dyspepsia it is a powerful irritant; I never trust baker's bread for poultices, for fear of the inflammation being increased by the alum.

Dr. Bernays says, "the prevalence of bad teeth amongst the English, is in part owing to their universal preference for white bread." *

Brown Bread, if genuine, is highly nutritious, from containing *bran* which is rich in phosphate of lime and other minerals and in plastic matter. Magendie fed a dog on white bread and water,—he died in forty days. He fed others on brown bread and water,—they flourished and grew fat.†

A *mess of boiled wheat* (firmity) or common unrefined *oatmeal porridge*, with sugar and milk, should be given once a week to growing children. If the latter is too irritating, the former should be selected.

* Household Chemistry, p. 82.

† Millon, Comptes Rendus, xxxviii. p. 40.

Captain's biscuits (flour and water only) are most valuable articles of diet, and may in many cases be most advantageously substituted for bread. Those with carraway seeds, (the husks when unbruised being indigestible) may be called *biscuits with thorns.*

Potatoes added to bread may be unobjectionable,—but they certainly displace better materials.

BEVERAGES.

203. Tea contains theine, tannin, and iron,—three stimulants. Coffee contains theine and a stimulating oil. Tapioca, Sago, and Rice, boiled in water, are most valuable articles of diet, and well supersede tea and coffee. They may be cooked with milk if desirable, and currant jelly or marmalade may be added to flavour them in dry feverish states, (§ 189) or orange or lemon-peal. Cocoa, if pure, has important advantages over every similar article of diet. Composed chiefly of farina, it contains in abundance a most nutritious and agreeable oil, which is supposed by some late writer to contain medicinal properties, equal to cod-liver-oil. If the oil disagrees, it can be removed when cold, (for it then hardens like suet on the surface) and the fluid be re-warmed, when it forms a delightful aromatic beverage. A most splendid specimen is sold by Marshall and Son, 20, Strand, at ten-pence per pound, under the name of "Rock Cocoa," which contains an abundance of oil,—a fragrant aromatic odour,—a mass of pure farina,—with

plastic and mineral ingredients. It is in fact meat, bread, and butter.

For sportsmen, for invalids, and delicate children, it is exceedingly valuable. As a general article of diet, it is most economical.

204. SACCHARINE COMPOSITIONS,

Sold in the shops, and called sweet-meats, are mostly of a diabolical, if not poisonous quality, from their colouring matter, and the sulphuric and acetic acids sold as citric acid. Sugar acts on the kidneys, and is a valuable diuretic, if the skin is cool; but a diaphoretic usually, if the skin is warmed: hence the value of treacle-posset in *colds*. Sugar morbidly formed in the stomach, and absorbed by the portal veins into the liver, creates *diabetes;* but if formed in the duodenum, as in health, it is a respiratory aliment. Medicated lozenges are most mischievous, from their unknown dose and composition. Some others are base frauds;* and such has been found to be the case with pounds of homœopathic globules, tested by Messrs. Brande and Farraday, who discovered that not an atom of the alleged drug entered into the composition of the large quantities which they examined.

SPIRITS AND WINE

205. Are cordials; but when administered in collapsed

* Jargonelle pear lozenges are flavoured with acetate of oxyde of formyle: apple lozenges by valerianate of formyle.

states (as in drowning), the capillaries must be invigorated by external warmth, before their materials can be appreciated.

Spirits form no fat—they precipitate ptyaline and pepsine (§ 50) and albumen,* and load the system with carbon. Hence gin-drinkers are blue and thin; and though their indulgence renders them free from phthisis, it entails other and equally fatal diseases. Our home-made wines are replete with acids, from too great exposure to the air during fermentation. (Liebig.) Beer contains similar acids, and carbonaceous matters in great excess. Therefore beer-drinkers take but little food (especially farinaceous and sugar), and their livid faces denote an excess of venous blood. Liebig says,† "Some English families adopted the plan, since the formation of Temperance Societies, of allowing their servants money in lieu of beer; but it was soon found that the weekly consumption of bread increased in a striking degree, so that the beer was *twice paid for;* once in money, and a second time in its equivalent of bread."

206. I have now given, in a condensed form, a great portion of what is known on the subject of food and dietation. I will, in conclusion, add a few remarks on the dietation of infants. An infant that does not suck its food may be encouraged to suck its thumb after taking food (§ 49); and it is astonishing how they fatten by so doing. Oatmeal relaxes; rice constipates;

* Surgical preparations are preserved by spirits.

† Letters on Chemistry, p. 454.

wheat-flour is neutral; and either of these three, boiled in water and cooled with new cow's milk, will at all times regulate a baby's bowels. Flesh-meat is inadmissible till the necessary masticatory instruments are provided by nature. Milk furnishes all the elements necessary for infantile life. Sugar should be given sparingly, as being the next stage to the formation of lactic acid (§ 134); farina is converted into nutritious sugar in the duodenum (§ 66). In flatulence, sickness, and *acidity*, a little bi-carbonate of soda, and a little weak clove-tea, will instantly remove them, and usually remove diarrhœa. Fibrinous meat hurries the formative process, encourages a lankey and thin growth, without symmetry, makes children excitable and "humoury;" and pre-disposes them to phthisis and other scrofulous diseases.

Fast growing children with small bones, should take a tea-spoonful or two of lime-water occasionally in a little milk and the yolk of an egg. In febrile states, sago and tapioca in water should be given, on account of their being low in the plastic scale.

207, To recapitulate my opinions on the subject of this work. I believe that the E. and N. E. winds dry up the skin and respiratory mucuous membrane; that they arrest the removal of lactic acid by the skin; that the mucuous membrane becomes loaded with this acid; that they set up the lactic acid diathesis. That lactic acid is generated to excess in the capillaries, the alcalinity of the blood is overpowered; that sugar and

farina undergo acidulous conversion, and that the mucous membranes elaborate lactic acid in excess. That the pneumogastric nerves sympathetically connect the respiratory organs with the stomach, and that other organs also are powerfully affected by the lactic acid diathesis. Under these circumstances fogs, and an atmosphere loaded with moisture or floating extraneous matters may also distress the sensitive larynx. The principles of treatment are to restore the healthy action of the skin; to neutralize free acid in the stomach, as well as in the blood, and to procure the proper alcaline ascendancy in the circulation. Lastly, to prevent a recurrence, and ensure a permanent cure by the *strictest attention* TO DIET. I may conclude by saying, that if I was forced by any strange coincidence to take my choice in the treatment of diseases (not immediately threatening life) with the use of medicine, or the regulation of diet, I would infinitely prefer the means placed at my disposal by the latter, and should rely with the greatest confidence on the powers afforded me by the vast resources of DIETATION.

FINIS.

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