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IN ITS RELATIONS TO

THERAPEUSIS.

A Paper read before the N. Y. Medical Journal Association, June 25th, 1869,

BY

ALFRED L. CARROLL, M. D.

Member of the Suffolk Institute of Letters, Arts, and Sciences; Corresponding Member of the Gynæcological Society of Boston, etc.

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The signification ordinarily attached to Hygiene, and endorsed by medical lexicographers, limits the scope of this department of medical science to the prevention of disease. If this definition were exclusively applicable, the study of Hygiene would present but little attraction to the great majority of practising physicians, whose services are seldom called for until the period of possible prophylaxis is past; and who are usually concerned, not with the "ounce of prevention," but with the "pound of cure."

Both etymology and experience, however, show that Hygiene has valid claims to be regarded as a curative science.[1]

[1] "De l'étude des effets hygièniques et des effets etiologiques des influences extérieures à l'étude de leurs effets therapeutiques, il n'y a aussi qu'un pas."—Ribes: *Traité d'Hygiène Thérapeutique. Paris.* 1869.

Mythology gives us two legends touching the genealogy of Hygeia. According to one account, she was the daughter of Æsculapius, and may reasonably be supposed to have aided her father in the healing art; the other fable, as told by Plutarch, relates that while the vestibule of the Athenian citadel was building under Pericles, one of the most skilful workmen fell down from the top to the bottom, and was so severely bruised that his life was despaired of by the physicians. Minerva, however, who was personally interested in the completion of the structure, informed Pericles in a dream of a remedy which speedily restored the patient, and in memory of this cure he placed near the altar a brazen statue of the goddess, conferring upon her the name of Hygeia, or the Minerva of Health.

Hippocrates, Celsus, Galen, and their contemporaries relied more upon hygienic measures than on the administration of drugs; in fact, faith in the *vis medicatrix naturæ* was generally held until the advent of that prince of quacks, Paracelsus, who may claim the doubtful credit of introducing the practice of antagonizing disease with active drugs.

Paré and Sydenham, too, were firm believers in nature's healing power; and so indeed, have been the majority of philosophical observers in our profession. In our own day this confidence in the operation of natural laws is daily gaining ground, and receiving additional confirmation from experience. Many maladies formerly supposed to demand the most energetic interference of medical art are now known to be self-limiting, with a natural tendency to termination in health, and not capable of being shortened or materially modified by the administration of drugs; and it seems probable that all so-called acute diseases may be classed in this category. In these, and in the treatment of disease generally, many, perhaps most, enlightened physicians of the present day, recognize the subordination of pharmaceutic agents to hygienic influences; there are some, however, who still award to the former the credit due to the latter, and who would be as much amazed to learn that they really cured their patients by means of "therapeutic hygiene" as Molière's hero was when informed that he had been unconsciously speaking prose all his days.

Whatever supernatural theories may be advanced with regard to the primal origin of animal existence, there are few who will deny that, in this nineteenth century at least, life and health result from the co-operation of physical and chemical laws, many of which are known to us, while others are yet the subjects of exact investigation. The study of these laws constitutes the domain of Physiology, which thus teaches us the conditions of health; Pathology, as far as it goes, shows us the nature and extent of deviations from health, or, in other words, which of the physiological conditions are deficient; Hygiene should, more than it now does, enable us to supply these absent conditions; and no department of medical science offers a more satisfactory field of investigation than this, since, while pharmaceutical treatment is inseparable from a certain amount of empiricism, Hygiene consists of rigorous logical deductions from demonstrable physiological data. Moreover, drugs, to exert remedial action, must possess toxic properties[2]—must *disturb*, to a greater

[2] "Medicines differ from poisons, not in their action, but in their doses." (*Pereira*)

or less degree, one or more of the physiological functions, while hygienic agents are selected from nature's simpler materia medica, and are free from noxious qualities. If it be granted that health is the normal state of life;—that the natural laws always tend to maintain health, or to restore it if it be disturbed;—that disease means impediment to the operation of these laws;—and that recovery (a far better word than "cure") implies, not the establishment of some new and artificial process in the economy, but simply a return to the normal state;—then the vast possibilities of hygienic treatment become evident, and we are better prepared to regard nature as the great active verb, and drugs as, at best, auxilia-

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"There is no natural difference between a *medicine* and a *poison*. All medicines are not poisons, nor is every poison necessarily a medic ine. But, with scarcely an exception, substances which, in a certain dose, are capable of destroying life, are also, in a certain less amount, adequate to save life. Their deleterious power is only an excess of their salutary power; and, generally, the former is proportioned to the latter." (*Stille.*)

With regard to the latter quotation it is obvious that, *mutatis mutandis*, it might with equal propriety be said that "substances which, in a certain dose, are adequate to save life, are also, in a certain greater amount, capable of destroying life," and that "their salutary power is only a deficiency of their deleterious power."

ries, necessary to qualify expression in certain moods and tenses, but only aiding, not giving, the full meaning.[8]

In order that I may not be supposed to have mounted a hobby which I am likely to ride to death, unduly exalting the virtues of natural agents and denying all efficacy to medicinal substances, I would state that for the purposes of this paper I classify morbid conditions under three heads:

1st.—Those (very few in number) which may be treated exclusively by drugs having a specific (toxic, physiological, or chemical) action, independently of hygienic influences. To these belong certain local diseases; cases of poisoning, whether animal, vegetable, or mineral; of mechanical obstruction; etc.

2d.—Those (a large majority, perhaps, in the present state of our knowledge,) which must be treated with drugs and hygienic agents combined, either of which would be insufficient without the

[8] "Les moyens qui tendent à guérir, sont premièrement, des actes de l'économie humaine, douée d'un pouvoir conservateur et médicateur; secondement, des agents hygièniques; troisièmement des agents pharmacologiques; quatrièmement des agents chirurgicaux." (RIBES: *op. citat.*)

other. Among them will be found many chronic organic diseases, especially those of the digestive and circulatory systems; some of the neuroses; etc.

3d.—A class, (much larger than is commonly supposed,) including not only the self-limiting diseases, but nearly all functional difficulties not dependent on lesions of structure; the various deviations from the normal standard of nutrition, etc., which may be most appropriately treated by hygienic means alone, to the exclusion of medicaments.

The hygienic agents which may be adapted to the treatment of disease are, chiefly:

1st.—Alimentation; including food, drink, so-called accessory food, and the employment of those mineral waters, or other substances, which supply elements deficient in the organism.

2d.—Air; including ventilation, hygrometric condition, density or rarefaction, artificial increase of the percentage of oxygen, etc.

3d.—Temperature; including climate, clothing, heating of rooms, etc.

4th.—Exercise; including its antithesis, rest; passive exercise; friction; etc.

5th.—Bathing, general or local.

6th.—Electrical influences.

7th.—Sunlight.

8th.—Agents, not included under any of the above heads, which affect one or more of the secretions or excretions.

Other influences of decidedly remedial nature exist in sleep, relaxation, mental and moral conditions; but these are less within our control, and although we may frequently recognize, and urge upon the patient their importance, neither we nor our clients can commonly enforce their operation.

On either of the divisions given above an entire course of lectures might be profitably delivered, or a separate work written. Within the compass of a single paper I can only offer a few general suggestions, in the hope of directing attention to the importance of the subject, and leading others, perhaps better qualified than myself, to deduce special applications to particular cases.

First in importance, whether in health or in dis-

ease, is alimentation, since it is evident that the raw material must be supplied before respiration can elaborate the manufactured product, and circulation carry it to repair the tissues. It may not unreasonably be asserted that in all organic diseases an essential part is played by what may be called Textural Starvation. Dr. Austin Flint, in an exceedingly able paper on "*Alimentation in disease*,"[4] remarks that "certain portions of the body may suffer from the want of materials in the blood proper for their nutrition, while other portions of the body are sufficiently nourished;" and quotes from Dr. S. B. Hunt's essay on "*Army Alimentation*,"[5] the following axiomatic paragraph: "Starvation is a comparative phrase. We can starve muscle by withholding nitrogen. We can starve the fats of the body, and destroy the animal heat, by withholding carbon. So, too, we can starve the brain by withholding phosphorus; and starve the blood by failing to supply it with those salts of lime, potash,

[4] *N. Y. Medical Journal*, February, 1868.

[5] *Sanitary Memoirs of the War of the Rebellion*, Vol. I. U. S. Sanitary Commission.

soda, iron, and magnesia, which are essential to its healthy condition."

Now, without pausing to criticise the impossibility of reducing to practice in health the voluntary ablation of many of the elements mentioned above, or to comment upon the almost miraculous manner in which nature decomposes and recombines atomic weights, so as to produce respiratory material from albuminous substances, I think I may advance as a self-evident proposition, that many if not most diseases depend upon defective supply or assimilation, or else upon excessive waste, of one or more of these essential elements. The distinction between supply and assimilation is obvious, since the mere ingestion of food, especially in disease, cannot fulfil the requirements of nutrition if the powers of assimilation in the tissues be deranged, and a patient may starve to death on four hearty meals a day. Now, it is evident that to meet such morbid conditions we have but two rational alternatives; either to increase the supply or to diminish the waste. The first of these ends is to be attained by alimentation, (with the aid, perhaps, of specific medication if assimilation be at fault); the second by pharmacological agents.

As a guide to the intelligent application of alimentation, and of hygienic agents capable of modifying the respiratory function, I have reduced from the French kilometres and grammes to English weights, the following table,[6] prepared from Barral's experiments on the human subject:

Amount in grs. (Troy) furnished and eliminated during every twenty-four hours for each pound (avoirdupois) weight of the body.

	C.	H.	N.	O.	Water.
Furnished by Alimentation...	53 90	8.39	4.20	49.00	294.73
Furnished by Respiration.....				156.12	
				205.12	
Eliminated by Skin and Lungs	49.42	7.62	2.17	202.60	121.18
Eliminated by Kidneys.....	2.24	0.42	1.61	1.19	157 94
Eliminated by Intestine.....	2.24	0.35	0.42	1.33	15.61
	53.90	8 39	4.20	205.12	294.73

In addition to these the respective tissues require: Sulphur, (found in albuminoid matter); Phosphorus, (of which meats contain a very large percentage in the form of soluble phosphates, but which is also furnished by most vegetable aliments); soda; potassa; magnesia; lime; iron. A knowledge of the chemical composition of the different substances

[6] Motard: *Traité d'Hygiène Générale*, Paris: J. B. Bailliere et Fils. 1868.

used as food will enable us to a great extent to compensate for the excess or deficiency of any of these elements.

The common division of alimentary substances into "plastic" and "respiratory," according as they conduce to tissue formation, or to the production of animal heat,—the former comprising nitrogenized substances, and the latter those rich in hydrogen and carbon,—although far from accurate, is convenient for general purposes. Both of these kinds of substances are contained in nearly every article of diet; but, as a rule, vegetable food is comparatively much richer in respiratory, and animal food in nitrogenized elements.[1] It is well known, however, that under a deficiency of the hydro-carbons, nitrogenized substances may be converted to respiratory purposes—indeed gelatin, which is highly nitrogenized, serves no plastic end, but is purely calorifacient; and it is not yet settled whether respiratory food may not to some extent be used for reparative purposes. The nervous tissue, at least,

[1] The comparative percentages of these elements in a few articles of vegetable food (water, salts, and insoluble fibres being omitted) are, approximately:

is doubtless nourished by fatty substances combining phosphorus from the mineral salts.[8]

To give even the most insufficient sketch of the vast subject of alimentation as specially adapted to the nutrition of the different tissues, and consequently to the treatment of various disorders, would require a review of all that has been lately done by Haughton,[9] Liebig,[10] and still more recently by Letheby.[11]

		Plastic	Respiratory
Rice		7.55	90.45
Corn		12.30	80.60
Wheat	from	14.60	66.40
	to	17.20	64.60
Barley		12.96	79.19
Rye		12.80	75.40
Oats		17.00	50.80
Peas		23.40	50.00
Beans		24.00	48.50
Potatoes		1.40	19.30
Cocoa and Chocolate		13.00	67.60

Meats contain:

	Fibrin and Albumen	Gelatin	Fatty matter
Veal	9.	7.5	16.5
Beef	8.	7.	20
Mutton	5.5	7.	40
Pork	4.5	5.5	50

Fish, according to species, contain: of nitrogenized matter, (including gelatin), from 13 to 24 per cent.; of fatty matter, from 6.36 to 13 per cent.

[8] Motard. *op. citat.*

[9] *Lancet*, Aug. 15th, 1868, *et seq.*

[10] *Lancet*, Jan 2d, 1869, *et seq.*

[11] *Chemical News* (Am. Reprint) Oct. 1868, *et seq.*

I must therefore content myself with giving a very few practical hints on a subject on which I would willingly enlarge.

The first rule I would lay down is to give as much nutriment as can be digested and assimilated —regard being had in special cases to the elements most needed, and to the comparative powers of gastric and intestinal digestion. Thus, for instance, we may have a case wherein respiratory food is called for, and yet the alkaline, intestinal digestive function may be inadequate, while the stomach is still in working order. Here, and in all cases where emaciation and innutrition are caused by excessive oxidation of albuminous matter, the ingestion of gelatin will be found useful, since it offers us respiratory materials digestible in the stomach.

Next to this first general principle of supporting the powers of nature, and endeavoring to secure the nutrition of all the tissues, we should ascertain what elements are redundant or deficient in any given disease, and increase or diminish the supply of these in our dietary list. Thus, where nervous power is defective, meats (which are rich in phosphates) or,

still better, fish, should enter largely into the regimen. Meats and milk also contain about one per cent. of iron, and should therefore form the chief portion of the diet in anæmic conditions. This mode of treatment is exemplified in the management of scurvy and some other disorders; my object is merely to suggest that it is susceptible of further refinement in detail, in order to fulfil the requirements of many morbid conditions. An indication not to be overlooked in this connexion may in many instances be derived from the particular desires of the patient. As the needs of the solids or fluids are generically expressed by the sensations of hunger or thirst, so specific wants of certain tissues are frequently shown by a craving for a certain kind of food. In winter we have an instinctive liking for fatty substances which are repugnant to us in summer, and, per contra, we fancy in hot weather acidulated drinks and non-respiratory substances, from which we are inclined to abstain in the colder months. In disease, within certain limits, a strong desire for a peculiar article of diet may often be regarded as the still small voice of some suffering

tissue, urging its wants above those of its fellows. Of course, due allowance must be made for the perversions of appetite which occur in many forms of disease.

The opposite mode of dietetic treatment—namely, by withholding certain elements—which is oftenest reduced to practice in the regimen of glycosuria, is also capable of modification to adapt it to some morbid states, although too nearly akin to the irrational "*cura famis*" of the ancients[12] to render its indiscriminate application advisable. In the rheumatic diathesis, where lactic acid is in excess, vegetables, containing starch and sugar, should be as far as possible avoided; where there is a tendency to excessive secretion of mucus, also, substances liable to undergo lactic fermentation should be to a great extent withdrawn. Other instances will occur to every one who is conversant with physio-

[12] Galen was a firm advocate of "starvation diet;" Valsalva recommended prolonged abstinence in aneurism; Récamier, in cancerous and other tumors; Buchan advised refrainment from liquids in dropsy; and an immense amount of nonsense has been written even in modern times concerning "rigorous diet," "partial diet," "common diet," "middle diet," "low diet," etc.

logy, wherein special modifications of diet are indicated. Of accessory food I have not time to speak further than to say that certain articles, prominent among which are tea, coffee, tobacco and alchohol, over and above any special qualities which they may possess, have the common property of diminishing the disintegration and absorption of albuminous tissues, and may therefore prove useful in compensating for a morbid tendency to excessive waste in this direction.

Before reluctantly closing my remarks on this branch of my subject, permit me to call attention to the fact that certain modes of treatment usually supposed to be medicinal, are in reality purely hygienic, and *vice versa*. For example, the administration of iron in anæmia, or of the phosphates or hypophosphites in nervous asthenia, is essentially hygienic, inasmuch as we simply supply in an assimilable form the alimentary principles which are wanting in the tissues. Cod liver oil is, of course, to be considered as food, not physic; and it is probable that as our knowledge advances, other substances, now regarded as successful drugs, will be added to the

list of aliments. If the conclusions of Dr. Dupré (erroneously attributed to Dr. Bence Jones) in relation to the existence of animal quinoidine as a normal constituent of the body, and its action in promoting fluorescence of tissues, be correct, it would seem as if quinine might already be transferred to this category.[13] Other substances, again, such as rice and arrowroot, are frequently spoken of as having a constipating effect, whereas this apparent result really arises from the fact that their digestion leaves very little excrementitious matter, and they are hence available where we wish to give rest to the lower bowel.

On the other hand various articles, such as tomatoes, figs, strawberries, etc., which are often prescribed as gentle hygienic laxatives, probably exert such action almost entirely through their indigestible seeds, which are simply mechanical irritants, and should therefore be avoided in irritable states of the intestinal canal.

The subject of ventilation is one so extensive in

[13] It is proper to add that Dr. Chalvet, in an essay read before the Société de Biologie, asserts that animal quinoidine is identical with quinine; and that it does not originate in the tissues, but is introduced in wine and vegetable food.

its bearings, and concerning which so little of a practical nature has been achieved, that it would be useless to attempt to solve any of its problems in the brief space which remains to me. The importance of getting rid of air which has been vitiated by respiration, and of supplying its place with a pure atmosphere, rich in oxygen, is manifest in disease even more than in health; and to secure this end, various ingenious plans have been devised. Without reviewing the comparative merits of these, I may remind you that owing to the very low conducting power of air, the interchange between two strata of different temperatures will be extremely slow unless they be mixed by agitation, and that as the expired air rises from its warmth, it will remain in an upper stratum if it find no outlet above, and virtually diminish the cubic space of a room for respiratory purposes. In cool weather a fire burning in an open fire-place, with an inlet for pure air in the upper part of the room, will offer about the best practicable means of ventilation. When the season permits, ventilation by displacement, or aeration by means of large openings (fully opened

doors and windows) is better than ventilation by the mere admixture of new air. To illustrate this, I may cite an example given in Dr. Motard's admirable treatise on Hygiene: If a given space, say 1000 cubic feet, has received from human respiration 5–10,000 parts of carbonic acid, it will contain altogether (5–10,000 being already normally present,) 1–1000 of this gas, which is the maximum amount compatible with a healthy atmosphere. If we now admix an equal volume (1000 cubic feet) of pure air, (containing 5–10,000 of carbonic acid,) instead of reducing the quantity one half, we only get 10-|-5÷2 or 7.5–10,000. If we introduce four times the volume, we get 10-|-20÷5, or 6–10,000. Nine times the volume would be required to reduce this amount the half of one ten-thousandth further (10-|-45÷10, or 5.5–10,000). Where there are large communications with the external air, the excess of carbonic acid is diffused very rapidly. Under all circumstances, at least 1000 cubic feet of air should be allowed every hour for each person in an apartment.

In the case of foreign gases, such as sulphuretted

hydrogen, or of diffusible miasmata, of course the admixture of a volume of air equal to that contaminated, would reduce the percentage to one-half; of three volumes, to one-fourth; etc. It should be borne in mind that the organic matter exhaled from the body, especially in most diseases, is more positively deleterious than carbonic acid.[14]

With regard to the hygrometric conditions of the air, we find two kinds of action: on the pulmonary and cutaneous surfaces. Dry air is a very bad conductor of heat; hence in a dry, cool atmosphere, the temperature of the body is lowered chiefly by radiation. On the respiratory organs, however, dryness of the air has a directly cooling action, owing to its affinity for moisture. The capacity for moisture, or point of saturation, varies enormously at different

[14] Carbonic acid is negatively deleterious on account merely of its insufficiency to support combustion; the emanations from the body are directly poisonous. In the case of the famous Black Hole of Calcutta, where, out of one hundred and forty-six prisoners, one hundred and twenty-three died within fourteen hours, the symptoms described by one of the survivors indicated, as Dr. Hammond remarks, intense animal poisoning, rather than asphyxia; and our daily observations of the morbid conditions produced by ochlesis show how rapidly and certainly such poisoning occurs under deficient ventilation.

temperatures; for instance, 100 cubic feet of air at –4° Fahr. will contain but 6.6 grs. of water, and at 104° will contain 216 grs. Now, if the amount of water present in a given volume of air be very far below the hygrometric capacity, this air will absorb water by evaporation until it is saturated; or it may be greatly reduced in temperature, before it will part with any moisture. This difference in the degree of humidity according to temperature, has a practical bearing upon the artificial heating of rooms. Thus, the air of a chamber containing 1000 cubic feet may be saturated at 32° Fahr., (its moisture representing, so to speak, 100–100); but if it be heated to 75°, this relative moisture will be reduced to about one quarter, or 25–100, and more than a half pound of water must be added to saturate it. The pulmonary action, under the latter circumstances, will be subjected to a refrigerating and desiccating process, until the requisite moisture is supplied.[15]

Constant humidity, by diminishing the exhalation from the body, and probably also through absorp-

[15] Motard. *op. citat.*

tion from without, increases nutrition, while it lessens innervation.

By a seeming contradiction in physics, while cold dry air, through its non-conducting property, acts in some sort as a conservator of animal heat, hot dry air, on the other hand, is to a certain extent a cooling agent, owing to the rapidity with which evaporation of the perspiration occurs. *Vice versa*, while a cold, humid atmosphere is a speedy refrigerant, warm, moist air augments the bodily heat. An important application of these principles lies in the distinction to be drawn between the action of vapor and hot-air baths, which many practitioners are in the habit of prescribing indifferently. The super-saturation of the vapor-bath prevents evaporation of the cutaneous perspiration, and the body accumulates caloric; while in the hot-air-bath, the vastly increased hygrometric capacity of the atmosphere greatly accelerates evaporation from both skin and lungs, and thus abstracts a large amount of heat. It is for this reason that the latter form of bath can be borne hotter and for a longer time than the former.

The effect of density of the air, irrespective of other conditions, has not been satisfactorily established. Increased atmospheric pressure has been supposed to accelerate the circulation mechanically, and "compressed air," on account of the greater amount of oxygen in a given bulk, is used empirically in some disorders.[16] Rarefied air, by rendering greater the relative weight of the body, causes a tendency to congestion and hæmorrhage; augments insensible perspiration; forces the lungs to more hurried action, by furnishing less oxygen in a given volume, and thus quickens the circulation.

Artificial increase of the percentage of oxygen in respired air would seem to be a rational measure in cases characterized by deficient oxygenation of the blood, especially in those where, from pulmonary disease, the respiratory capacity is diminished; indeed, numerous gratifying results have been report-

[16] Dr. G. Von Liebig has recently announced in the *Zeitschrift fur Biologie*, as conclusions derived from a number of experiments with compressed air, that when the subject becomes accustomed to breathing in the denser medium, there is no material difference in the number of respirations per minute, the quantity of air respired, or the amount of carbonic acid eliminated.

ed from this mode of treatment. If the collapse of cholera depends, as is generally supposed, upon paralysis of the capillaries and the stagnation within them of deoxygenated blood, I would suggest the immersion of the patient's body (the head being excluded) in an atmosphere of oxygen, with the view of obtaining osmosis through the walls of the superficial capillaries. This might be tried by means of an oiled-silk or india-rubber bag, closed around the patient's neck, into which oxygen might be introduced.

Of the effects of ozone upon the animal organism we know very little as yet. It seems possible, however, that its energetic chemical affinities and great oxidizing power may exert a marked influence on many acts of nutrition. According to Dr. Hammond,[17] this influence is of a destructive nature, and he is inclined to agree with Schönbein in attributing catarrhal epidemics to a superabundance of ozone. Opposed to this view is the circumstance, recently suggested to me by Professor Joy, that residence in an atmosphere impregnated with the

[17] Hammond. *A Treatise on Hygiene.* p. 164.

emanations from the pine and other balsamic conifers, is frequently advised as a remedial measure, and that these trees give rise to considerable quantities of ozone. It should be added that some chemists deny the presence of ozone in the atmosphere, attributing the reactions observed with ozonometric tests to the azotite of ammonia, whose presence and mode of formation were demonstrated by Schönbein.[18]

The question of climate embraces too many important considerations for me to attempt to enter upon it here. I can only say in brief, that a tendency to visceral engorgements, or to hæmorrhagic troubles, should be met by a warm, humid, and not too elevated locality; scrofulous, dropsical or diarrhœal disorders, and generally those accompanied by excessive mucous secretion, call for warmth and dryness; many nervous maladies will be benefited by a temperate climate combined with moisture. The well known effects of dry, hot climates in caus-

[18] Combustion in a moist atmosphere, according to Schönbein, or even simple evaporation of water, may produce this substance, three equivalents of water and two of nitrogen concurring in its formation—$3HO + 2N = (NO_3 + NH_3)$. Hence, probably, its increase during rain.

ing derangements of the liver and bowels, sufficiently indicate the opposite conditions to be sought for their relief. The influence of climates with regard to temperature alone, may be generally stated thus: Heat tends to increase the activity of nutrition; but at the same time the amount of caloric which must be carried off by transpiration induces, by calling an excess of blood to the surface, a sluggishness of the digestive function, and rapid exhaustion. It is a singular circumstance that while all the other secretions are lessened by the abundance of perspiration, those of bile and semen are, on the contrary, increased in hot climates. The fact that the skin may be made to act vicariously for the kidneys, points to the value of hot dry climates, either natural or artificial (as the hot-air bath) in some renal disorders, if not otherwise contra-indicated.

Cold, on the other hand, diminishes the cutaneous action, drives the blood from the surface to internal organs, renders the circulation sluggish, and increases the secretions generally.

From what has been said at large of temperature

I must leave the obvious inferences to be drawn regarding clothing and artificial heating of rooms. I cannot refrain, however, from protesting against our American fondness for furnace and stove heat without provision for increased evaporation of water to supply the increased hygrometric capacity of the heated air. Whether carbonic oxide be given out by cast iron stoves or not, (a question which, despite the experiments of Deville and Troost, is yet unsettled), there can be no doubt that the excessive desiccation of the air does much to produce our almost national tendency to difficulties of the throat, and that consequently stove heat is extremely objectionable in the sick-room, unless care be taken to supply moisture to the air—a precaution too generally neglected. The additional advantage of an open fire-place as a means of ventilation has already been spoken of.

On the importance of exercise, active or passive, I have not time to dwell. It is a physiological axiom that exercise is essential to the healthy performance of all the functions; but there are many morbid states in which rest is not only indi-

cated but necessitated. Of the various gradations of such states much might be said; suffice it for the present to generalize by stating that where excessive oxidation is going on, and the nutritive resources must be husbanded, rest is indicated; under other circumstances, exercise—within limits to be determined for each individual case—is even more important in disease than in health. By exercise, I do not mean the violent and unnatural gymnastic exertions frequently understood by that name. Artificially induced hypertrophy of certain muscles at the expense of the rest of the system, can never be beneficial. It seems more than probable that disease of the right heart, though of comparatively rare occurrence, is oftener produced by habitual excessive muscular exertion than by any other cause, and the prevalence of cardiac disturbance among acrobats is a matter of statistics. Like everything else that is of use when properly managed, exercise as a therapeutic agent has been adopted as a sort of cure-all by the "Kinesopathists" and by the projector of the "lifting cure."

To discuss the subject of bathing in all its rela-

tions would require a separate and voluminous paper. The first and most evident effects of baths are those dependent on temperature and on the high conducting power of water, of which I have before spoken. Cold baths, by driving the blood from the surface and rapidly abstracting caloric, are likely to prove injurious in enfeebled subjects, or where there is a tendency to congestion or hæmorrhage. Under ordinary circumstances, this effect is more than neutralized by the subsequent cutaneous reaction, especially if aided by friction. The cold shower-bath, by adding a stronger physiological impression on the nerves to the physical effects of cold, becomes the most trying mode of applying water to the general surface. In connexion with warm baths the question of absorption and exhalation from the cutaneous surface arises, and on this point numerous experiments have been conducted by Seguin, Buchan, Falconner, Berthold, Edwards, Marquart, and others. The solution of apparent discrepancies in their observations seems to be, that there is a point (a few degrees below blood-heat) at which neither absorption nor exhalation occurs;

that within a certain limit below this point, absorption takes place, probably by simple endosmosis; that above this point, the warmth excites perspiration. Although water is a better conductor than air, it cannot carry off as much heat from the body as is ordinarily abstracted by the evaporation of the insensible perspiration; hence a bath not exceeding the normal temperature of the blood will have the effect of surcharging the economy with caloric. [19]

The indications for local bathing are given in so many text-books on surgery that I need not mention them here.

The field of electro-therapeutics is too vast for me to enter on, even did I feel qualified to deal with so intricate a branch of study. Moreover, although great advances have been made in this direction within the last few years, and although every day adds to our knowledge of the practical benefits derived from the use of electricity, the rationale of its action and the circumstances which call for the continued or the induced current, are still subjects for further investigation. Assuming the "*vis nervosa*"

[19] Motard: *op. citat.*

to be nearly akin to, if not identical with electricity, it seems probable that the sensation of lassitude and general *malaise* frequently experienced in damp weather may be connected with the increased conducting power of an atmosphere laden with moisture.

Inasmuch as a few physicians, and very many nurses, still adhere to the pernicious practice of darkening sick-rooms, I would say a few words concerning the hygienic importance of sun-light. The chemical influence of light may be inferred from the effects resulting from its absence. Among these are: arrests of development in various degrees; scrofulous maladies; anæmic conditions; œdematous and dropsical affections; irritability of the heart and nervous system; tendency to syncope and hæmorrhages;[20] etc. Goitre and cretinism are also supposed to depend to a great extent on insufficiency of light. Dr. Forbes Winslow, quoting Virchow, says:[21] "It is a well-established fact that, as the effect of isolation from the stimulus of light, the fibrin,

[20] Forbes Winslow: *Light: its Influence on Life and Health.* 1868.

[21] *Ibid.*

albumen, and red blood-cells become diminished in quantity, and the serum, or watery portion of the vital fluid, augmented in volume, thus inducing a disease known to physicians and pathologists by the name of leukæmia. * * * * The absence of these essential elements of health deteriorates, by materially altering, the physical composition of the blood, thus seriously prostrating the vital strength, enfeebling the nervous energy, and ultimately inducing organic changes in the structure of the heart, brain, and muscular tissue." Effects the opposite of these are to be obtained by the free admission of sun-light into the rooms of the sick or convalescent; and this should be done in nearly all cases except those of ophthalmic disease, or where acute cerebral or meningeal attacks forbid it. Dr. Hammond remarks:[22] "In chlorosis, scrofula, phthisis, and, in general, all diseases characterized by deficiency of vital power, light should not be debarred. In convalescence from almost all diseases it acts, unless too intense or too long continued, as a most healthful stimulant, both to the nervous and physical systems. * * *

[22] *Op. citat.* p. 210.

The delirium and weakness, which are by no means seldom met with in convalescents kept in darkness, disappear like magic when the rays of the sun are allowed to enter the chamber. I think I have noticed that wounds heal with greater rapidity when the light is allowed to reach them, than when they are kept continually covered."

Fraunhofer demonstrated the existence of metallic constituents in the solar spectrum, and it has since been shown that sun-light offers iron, sodium, magnesium, calcium, chromium, nickel, barium, copper, zinc, and hydrogen. It has been suggested that the "vapor of iron" may have a direct therapeutic action on the blood in the superficial capillaries, and Forbes Winslow adds :[23] "In the absence of any hypothesis of a more satisfactory character to account for the beneficial action of light, it is reasonable to suppose that the iron vapor detected in the sun's beams may have a physiological as well as a mechanical effect upon the composition of the blood, by throwing into the general circulation, through the vessels of the skin, a most important vital constituent."

[23] *Op. citat.*

I regret exceedingly that I have been forced to pass over many points which, I think, have important practical bearings upon therapeutic art; and to deal so hurriedly and inadequately with those on which I have touched. I should have liked to take up certain typical diseases seriatim, and from the study of their pathology to deduce, as far as lay in my power, the hygienic measures appropriate to their treatment; I should have liked, in the few instances where I have advanced views not sanctioned by common acceptance, to give more fully and intelligibly the arguments on which they are founded. The magnitude of the subject, and the probable limit of human endurance in my auditors, must be my excuse for the shortcoming of which I am fully conscious. If I have succeeded to any extent, however, in directing attention to the possible application of hygienic agents to special pathological indications, I shall have fulfilled the only purpose I had in view.