financial considerations. It is evident that in foreign parts, or in any place where there is a difficulty in disposing of the ammonia, the obtaining of the same in a dry form offers several advantages as compared with having it as a weak solution.

RECONVERSION OF NITRO-GLYCERIN INTO GLYCERIN.

By C. L. BLOXAM.

THE following experiments on this subject appear to possess some interest at the present moment:

1. Nitro-glycerin was shaken with methylated alcohol, which dissolves it readily, and the solution was mixed with an alcoholic solution of KHS (prepared by dissolving KHO in methylated spirit, and saturating with H_2S gas). Considerable rise of temperature took place, the liquid became red, a large quantity of sulphur separated, and the nitro-glycerin was entirely decomposed.

2. Nitro-glycerin was shaken with a strong aqueous solution of commercial K_2S . The same changes were observed as in 1, but the rise of temperature was not so great, and the liquid became opaque very suddenly when the decomposition of the nitro-glycerin was completed.

3. The ordinary yellow solution of ammonium sulphide used in the laboratory had the same effect as the K_2S . In this case the mixture was evaporated to dryness on the steam bath, when bubbles of gas were evolved, due to the decomposition of the ammonium nitrite. The pasty mass of sulphur was treated with alcohol, which extracted the glycerin, subsequently recovered by evaporation. Another portion of the mixture of nitro-glycerin with ammonium sulphide was treated with excess of $PbCO_3$ and a little lead acetate, filtered, and the ammonium nitrite detected in the solution. These qualitative results would be expressed by the equation—

which is similar to that for the action of potassium hydro-sulphide upon gun-cotton.

4. Flowers of sulphur and slaked lime were boiled with water, till a bright orange solution was obtained. This was filtered, and some nitro-glycerin powdered into it. The reduction took place much more slowly than in the other cases, and more agitation was required, because the nitro-glycerin became coated with sulphur. In a few minutes, the reduction appearing to be complete, the separated sulphur was filtered off. The filtrate was clear, and the sulphur bore hammering without the slightest indication of nitro-glycerin.

This would be the cheapest method of decomposing nitro-glycerin. Perhaps the calcium sulphide of tank-waste, obtainable from the alkali works, might answer the purpose.—*Chemical News.*

CARBONIC ACID AND BISULPHIDE OF CARBON.*

By JOHN TYNDALL, F.R.S.

CHEMISTS are ever on the alert to notice analogies and resemblances in the atomic structure of different bodies. They long ago indicated points of resemblance between bisulphide of carbon and carbonic acid. In the case of the latter we have one atom of carbon united to two of oxygen, and in the case of the former one atom of carbon united to two of sulphur. Attempts have been made to push the analogy still further by the discovery of a compound of carbon and sulphur analogous to carbonic oxide, but hitherto, I believe, without success. I have now to note a resemblance of some interest to the physicist, and of a more settled character than any hitherto observed.

When, by means of an electric current, a metal is volatilized and subjected to spectrum analysis, the "reversal" of the bright band of the incandescent vapor is commonly observed. This is known to be due to the absorption of the rays emitted by the vapor by the partially cooled envelope of its own substance which surrounds it. The effect is the same in kind as the absorption by cold carbonic acid of the heat emitted by a carbonic oxide flame. For most sources of radiation carbonic acid is one of the most transparent of gases; for the radiation from the hot carbonic acid produced in the carbonic oxide flame it is the most opaque of all.

Again, for all ordinary sources of radiant heat, bisulphide of carbon, both in the liquid and vapor form, is one of the most diathermanous bodies ever known. I thought it worth while to try whether a body reputed to be analogous to carbonic acid, and so pervious to most kinds of heat, would show any change of deportment when presented to the radiation from hot carbonic acid. Does the analogy between the two substances extend to the vibrating periods of their atoms? If it does, then the bisulphide, like the carbonic acid, will abandon its usually transparent character, and play the part of an opaque body when presented to the radiation from the carbonic oxide flame. This proved to be the case. Of the radiation from hydrogen, a thin layer of bisulphide transmits 90 per cent., absorbing only 10. For the radiation from carbonic acid, the same layer of bisulphide transmits only 25 per cent., 75 per cent. being absorbed. For this source of rays, indeed, the bisulphide transcends, as an absorbent, many substances which, for all other sources, far transcend it.

THE HAIR, ITS USE AND ITS CARE.†

By JOHN V. SHOEMAKER, A.M., M.D., Physician to the Philadelphia Hospital for Skin Diseases.

THE object of this paper is to briefly describe the hair and its important functions, and to suggest the proper manner of preserving it in a healthy state.

I know full well that much has been written upon this useful part of the human economy, but the constant increase of bald heads and beardless faces, notwithstanding all our modern advancement in the application of remedies to the cure of disease, prompts me to point out to you the many ways of retaining, without medication, the hair, which is a defense, ornamentation, and adornment to the human body.

[Dr. Shoemaker here gave an interesting history of the growth and development of the hair and its uses, which we are compelled to omit. Then, proceeding, he said:] Now, the hair, which fulfills such an important function in the adornment and health of the body, requires both constitutional and local care to keep it in its normal, healthy state. When I say constitutional care, I mean that the various organs of the body that assist in nourishing and sustaining the hair-forming apparatus should, by judicious diet, exer-

cise, and attention to the nervous system, be kept healthy and sound, in order that they in turn may assist in preserving the hairs in a vigorous condition.

In the first place, that essential material, food, which is necessary to supply the waste and repair of all animal life, should be selected, given, or used according to good judgment and experience.

Thus, mothers should feed their infants at regular intervals according to their age, and not permit them to constantly pull at the breast or the bottle until the little stomach becomes gorged with food, and some alimentary disorder supervenes, often setting up a rash and interfering with the growth and development of the hair. It is likewise important, in case the baby must be artificially fed, to select good nutritious food as near as possible like the mother's—cow's milk, properly prepared, being the only recognized substitute. Care and discretion should likewise be taken by parents and nurses, after the infant has developed into childhood, to give simple, substantial, and varied food at regular periods of the day, and not in such quantities as to overload the stomach. Children need active nutrition to develop them into robust and healthy men and women; and it is from neglect of these important laws of health, and in allowing improper food, that very often bring their results in scald head, ring-worm, and scurf, that leave their stamp in the poor development of the hair. With the advent of youth and the advance of years, food should be selected and partaken of according to the judgment and experience of its acceptable and wholesome action on the consumer.

The meals should also be taken at regular intervals. At least four hours should be left between them for the act of digestion and the proper rest of the stomach.

It is, on the contrary, when the voice of nature has been stifled, when judgment and experience have been set aside, that mischief follows; when the stomach is teased and fretted with overloading, and the food gulped down without being masticated, gastric and intestinal derangement supervenes, which is one of the most prolific sources of the early decay and fall of the hair.

The nervous system, which is one of the most important portions of the human structure, and which controls circulation, secretion, and nutrition, often by being impaired, plays a prominent part in the production of baldness. Thus, it has been demonstrated by modern investigation that the nerves of nutrition, by their defective action, are often the cause of thinning and loss of hair. The nutritive action of a part is known to suddenly fail, the hair-forming apparatus ceases to act, the skin changes from a peculiar healthy hue to a white and shining appearance, and often loses at the same time its sensibility; the hairs drop out until very few remain, or the part becomes entirely bald. It is the over-taxing of the physical powers, excessive brain work, the exacting demands made by parents and teachers upon children's mental faculties, the loss of sleep, incessant cares, anxiety, grief, excitement, the sudden depression and exaltation of spirits, irregular and hastily bolted meals, the lack of rest and recreation, the abuse of tobacco, spirits, tea, coffee, and drugs of all forms, that are fruitful sources of this defective action of the nerves of nutrition, and consequent general thinning and loss of hair.

The hair, particularly of the head, should also receive marked local attention. In reference to the use of coverings for it, I know of no better rules than those which I laid down in my chapter on clothing in "Household Practice of Medicine" (vol. i., p. 218, William Wood & Co., New York), in which I state that the head is the only part of the body so protected by nature as to need no artificial covering.

The stiff hats so extensively worn by men produce more or less injury. Premature baldness most frequently first attacks that part of the head where pressure is made by the hat. It is, indeed, a pity that custom has so rigidly decreed that men and women must not appear out of doors with heads uncovered. It would be far better for the hair if to be bare-headed were the rule, and to wear a hat the exception.

Since we cannot change our social regulations in this respect, we should endeavor to render them as harmless as possible.

The forms of hats that are least injurious are: for Winter, soft hats of light weight, having an open structure, or pierced with numerous holes; for Summer, light straws, also of open structure.

As regards the head-covering of women, the fashions have been for several years favorable to proper form. The bonnet and hat have become quite small, and cover but little of the head. This beneficial condition, however, is in part counterbalanced by the weight of false curls, switches, puffs, etc., by the aid of which women dress the head. These, by interfering with evaporation of the secretions, prevent proper regulations of the temperature of the scalp, and likewise lead to the retention of a certain amount of excrementitious matter, both of which are prolific sources of rapid thinning and loss of hair in women.

False hair has likewise sometimes been the means of introducing parasites, which give rise to obstinate affections of the scalp.

Cleanliness of the entire surface of the skin should next demand attention, and that should be done by using water as the medium of ablution. It is a well-known physiological law that it is necessary, in order to enable the skin to carry on its healthful action, to have washed off with water the constant cast of scales which become mingled with the unctuous and saline products, together with particles of dirt which coat over the pores, and thus interfere with the development of the hairs. Water for ablution can be of any temperature that may be acceptable and agreeable, according to the custom and condition of the bather's health. Many chemical substances can be combined with water to cleanse these effete productions from the skin. Soap is the most efficacious of all for cleanliness, health, and the avoidance of disease. Soap combines better with water to render these unctuous products miscible, and readily removes them thoroughly from the skin. The best variety of soap to use is the pure white soap, which cannot be so easily adulterated by coloring material, or disguised by some perfume or medicinal substance. Ablution with soap and water should be performed once or twice a week at least, particularly to the head and beard, in order to keep open the hair tubes so that they may take in oxygen, give out carbon, carry on their nutrition, and maintain the hairs in a fine, polished, and healthy condition. In using water to the scalp and beard, care should be taken not to use soap-water too frequently, as it often causes irritation of the glands, and leads to the formation of scurf. It is equally important to avoid using on the head the daily shower-bath, which, by its sudden, rapid, and heavy fall, excites local irritation, and, as a result, loss of hair quickly follows. In case the health demands the shower-bath, the hair should

be protected by a bathing cap. The most acceptable time to wash the hair, to those not accustomed to doing it with their morning bath, is just before retiring, in order to avoid going into the open air or getting into a draught and taking cold. After washing, the hair should be briskly rubbed with rough towels, the Turkish towel heated being particularly serviceable. Those who are delicate or sick, and fear taking cold or being chilled from the wet or damp hairs, should rub into the scalp a little bay rum, alcohol, or oil, a short time after the parts have been well chafed with towels. The oil is particularly serviceable at this period, as it is better absorbed, and at the same time overcomes any dryness of the skin which often follows washing.

It might be well to add in this connection that I have frequently been consulted, by those taking salt-water baths, as to the care of the hair during and after the bath. If the bather is in good health, and the hair is normal, the bather can go into the surf and remain at least fifteen minutes, and on coming out should rub the hair thoroughly dry with towels.

Ladies should permit it remain loose while doing so, after which it can be advantageously dressed.

It is, however, often injurious to both men and women having some wasting of the hair to go into the surf without properly protecting the head; the sea water has not, as is often thought, a tonic action on the scalp; on the contrary, it often excites irritation and general thinning. Again, it is most decidedly injurious to the hair for persons to remain in the surf one or two hours, the hair wet, and the head unprotected from the rays of the sun. This latter class of bathers, and those who hurriedly dress the hair wet, which soon becomes mouldy and emits a disagreeable odor, are frequent sufferers from general loss and thinning of the hair.

An agreeable and efficient adjunct after ablution, which I have already referred to, is oil. Oil has not only a cleansing action upon the scalp, but it also overcomes any rough or uneven state of the hair, and gives it a soft and glossy appearance.

The oil of ergot is particularly serviceable in fulfilling these indications, and, at the same time, by its soothing and slight astringent action upon the glands, will arrest the formation of scurf. In using oil, the animal and vegetable oils should always be preferred, as mineral oils, especially the petroleum products, have a very poor affinity for animal tissues.

Pomatum is largely used by many in place of oil, as it remains on the surface and gives a full appearance to the hairs, thus hiding, sometimes, the thinness of the hair.

It will do no harm or no special good if it contains pure grease, wax, harmless perfume, and coloring matter, but it is often highly adulterated, or, the fat in it decomposing, sets up irritation on the part to which it is applied. I therefore always advise against its use.

The comb and brush are also agents of the toilet by which the hair is kept clean, vigorous, and healthy. The comb should be of flexible gum, with large, broad, blunt, round, and coarse teeth, having plenty of elasticity. It should be used to remove from the hairs any scurf or dirt that may have become entangled in them, to separate the hairs and prevent them from becoming matted and twisted together.

The fine-tooth comb, made with the teeth much closer together, can be used in place of the regular toilet comb just named when the hair is filled with very fine particles of scurf, dirt, or when parasites and their eggs infest the hairs. It should, however, always be borne in mind that combs are only for the hair, and not for the scalp or the skin, which is too often torn and dug up by carelessly and roughly pulling these valuable and important articles of toilet through the skin as well as the hair.

The brush with moderately stiff whalebone bristles may be passed gently over the hair several times during the day, to brush out the dust and the dandruff, and to keep the hair smooth, soft, and clean; rough and hard brushing the hair with brushes having very stiff bristles in them, especially the metal or wire bristles, is of no service, but often irritates the parts and causes the hair to fall out. [Dr. Shoemaker then denounced the use of the so-called electric brush, saying its use was injurious, as also was the effort to remove dandruff by the aid of the comb and brush. Continuing, he remarked:] And now the question arises, Should the hair be periodically cut? It may be that cutting and shaving may for the time increase the action of the growth, but it has no permanent effect either upon the hair-bulb or the hair sac, and will not in any way add to the life of the hair.

On the contrary, cutting and shaving will cause the hair to grow longer for the time being, but in the end will inevitably shorten its term of life by exhausting the nutritive action of the hair-forming apparatus. When the hairs are frequently cut, they will usually become coarser, often losing the beautiful gloss of the fine and delicate hairs. The pigment will likewise change—brown, for instance, becoming chestnut, and black changing to a dark brown. In addition, the ends of very many will be split and ragged, presenting a brush-like appearance. If the hairs appear stunted in their growth upon portions of the scalp or beard, or gray hairs crop up here and there, the method of clipping off the ends of the short hairs, of plucking out the ragged, withered, and gray hairs, will allow them to grow stronger, longer, and thicker.

Mothers, in rearing their children, should not cut their hair at certain periods of the year (during the superstitious time of full moon), in order to increase its length and luxuriance as they bloom into womanhood and manhood. This habit of cutting the hair of children brings evil in place of good, and is also condemned by the distinguished worker in this department, Professor Kaposi, of Vienna, who states that it is well known that the hair of women who possess luxuriant locks from the time of girlhood never again attains its original length after having once been cut.

Pincus has made the same observation by frequent experiment, and he adds that there is a general opinion that frequent cutting of the hair increases its length; but the effect is different from that generally supposed. Thus, upon one occasion he states that he cut off circles of hair an inch in diameter on the heads of healthy men, and from week to week compared the intensity of growth of the shorn place with the rest of the hair. The result was surprising to this close and careful observer, as he found in some cases the numbers were equal, but generally the growth became slower after cutting, and he has never observed an increase in rapidity.

I might also add that I believe many beardless faces and bald heads in middle and advancing age are often due to constant cutting and shaving in early life. The young girls and boys seen daily upon our streets with their closely cropped heads, and the young men with their clean-shaven

* A paper read before the Royal Society, April 5, 1883.

† Abstract of a paper read before the Pennsylvania State Medical Society, at Norristown, May 10, 1883.—*N. Y. Med. Jour.*

faces, are, year by year, by this fashion, having their hair-forming apparatus overstrained.

I also must condemn the modern practice of curling and crimping, the use of bandoline, powders, and all varieties of gum solutions, sharp hair-pins, long-pointed metal ornaments and hair combs, the wearing of chignons, false plaits, curls, and frizzes, as the latter are liable to cause headaches and tend to congestion. Likewise I protest against the use of castor-oil and the various mixtures extolled as the best hair-tonics, restoratives, vegetable hair-dyes, or depilatories, as they are highly injurious instead of beneficial, the majority of hair-dyes being largely composed of lead salts. But, should your patients wish to hide their gray hairs, probably the best hair-dye that can be used safely is pyrogallol acid or walnut juice, the hairs being first washed with an alkaline solution to get rid of the grease. Nitrate of silver is also a good and safe hair-dye, but its application should be done by one experienced in its use. The judicious use of these hair-dyes will give the hair above the surface of the skin a brownish-black appearance, the intensity of the color of which depends upon the strength of the solution. But hair-dyeing for premature grayness should be avoided, as the diseased condition may be averted by the proper remedies. Never permit the hair to be bleached for the purpose of obtaining the fashionable golden hue, as the arsenical solution generally used is highly dangerous; but, if your patients must have their hair of a golden color, insist upon their hairdresser using the peroxide of hydrogen, which is less dangerous than the preparation first mentioned.

Perhaps one of the most pernicious compounds used for the hair at the present day is that which is sold in the shops as a depilatory. It is usually a mixture of quicklime and arsenic, and is wrongly used and recommended at this time by many physicians to remove hairy moles and an excessive growth of hair upon ladies' faces. Its application excites inflammation of the skin; and, while it removes the hair from the surface for a time, it often leaves a scar, or makes the part rough, congested, and deformed.

In the meantime, the hair will grow after a short period stronger, coarser, and changed in color, which will even more disfigure the person's countenance. With the present scientific knowledge of the application of electrolysis, hairs can be removed from the face of ladies or children, or in any improper situation, in the most harmless manner without using such obnoxious and injurious compounds as depilatories.

In conclusion, let me add that, if the hair becomes altered in texture, or falls out gradually or suddenly, or changes in color, a disease of the hair, either locally or generally, has set in, and the hair, and perhaps the constitution, now needs, as in any other disease, the constant care of the physician.

A general remedy for this or that hair disease that may develop will not answer, as hair diseases, like other affections, have no one remedy which will overcome wasting, thinning, or loss of color. Patients reasoning upon this belief, frequently apply to me for a remedy to restore their hair to its full vigor or give them back its color. I always reply that I have no such remedy.

The general health, as well as the scalp and hairs, must be examined carefully, particularly the latter, with the lens and microscope. All changes must be watched, and the treatment varied from time to time according to the indications.

No one remedy can, therefore, under any circumstances, suit, as the remedy used to-day may be changed at the next or succeeding visit. No remedy for the hair will be necessary if the foregoing advice be followed which I have just narrated, and which is the result of some seven years of labor and experience.

The proper consideration and putting into practice of these suggestions will most certainly secure to the rising generation fewer bald heads and more luxuriant hair than is possessed at the present day.

[Concluded from SUPPLEMENT No. 387, page 6179.]

THE INFLUENCE OF EFFECTIVE BREATHING IN DELAYING THE PHYSICAL CHANGES INCIDENT TO THE DECLINE OF LIFE, AND IN THE PREVENTION OF PNEUMONIA, CONSUMPTION, AND DISEASES OF WOMEN.

By DAVID WARK, M.D., 9 East 12th Street, New York.

PNEUMONIA.

DURING the past winter inflammation of the lungs has destroyed the lives of many persons who, although they were in most cases past the meridian of life, yet still apparently enjoyed vigorous health, and, I have little doubt, would still have been alive and well had the preventive means here laid down against the occurrence of the disease from which they perished been effectively practiced at the proper time.

The most important anatomical change occurring during the progress of pneumonia is the solidification of a larger or smaller part of one or both lungs by the deposit in the terminal bronchial tubes and in the air cells of a substance by which the spongy lungs are rendered as solid and heavy as a piece of liver. The access of the respired air to the solidified part being totally prevented, life is inevitably destroyed if a sufficiently large portion of the lungs be invaded.

This deposit succeeds the first or congestive stage, and it occurs with great rapidity; an entire lobe of the lung may be rendered perfectly solid by the exudation from the blood of fully two pounds of solid matter in the short space of twelve hours or even less. The rapidity with which the lungs become solidified amply accounts for the promptly fatal results that often attend attacks of acute pneumonia. If recovery takes place, the foreign matter by which the lung tissue has been solidified is perfectly absorbed and the diseased portion is found to be quite uninjured. The only natural method by which the blood can be freed from the presence of foreign matter is by the oxidation—the burning—of such impure matters; the results being carbonic acid gas that escapes by the lungs and certain materials that are eliminated chiefly by the kidneys. But when these blood impurities exist in the vital fluid in unusually large quantities, or if the respiratory capacity be inadequate, the natural internal crematory operations are a partial failure. But nature will not tolerate the presence of such impurities in the vital fluid; if they cannot be eliminated by natural means they must by unnatural means; therefore such material is very frequently deposited in various parts of the body, the point of deposit being often determined by some local disturbance or irritation.

For instance, if a person whose blood is in fairly good condition takes a cold that settles on his lungs, he either recovers of it spontaneously or is readily cured by means of

some cough mixture; but if his blood be loaded with tubercular matter, the latter is extremely liable to be deposited in his lungs; the cough that was excited in the first place by a simple cold becomes worse and persistent, in a few months his lungs show signs of disorganization, and he has consumption of the acute or chronic type, as the case may be.

On the other hand, if the impure matter by which the blood is loaded be of the kind that causes the pulmonary solidifications of pneumonia, the latter disease is very likely to be developed if a cold on the lungs be caught.

The liability of any individual to attacks of acute pneumonia is therefore determined very largely by the presence or absence in his blood of the matter already alluded to. If his blood be free from it, no cold, however severe, is competent to originate the disease.

There can be no question but that good living and sedentary habits have a strong tendency to befoul the blood; the former renders effective respiration all the more necessary for the removal from the blood of whatever nutritive matter has been taken beyond the needs of the system, and the latter inevitably diminishes the respiratory motions to the lowest point consistent with physical comfort. From these conditions originates the active predisposing cause of pneumonia, to which we have already alluded.

The disease is more fatal in the very young and in the aged; the mortality seems to bear a direct ratio to the respiratory capacity; in young subjects the breathing powers have not been fully developed like the other physical capacities, while in the old the respiratory volume has been diminished by the stiffening of the chest walls and of the lungs by the senile changes already detailed.

There can be no question but that protection from cold and judicious attention to the health generally, by suitable exercise and diet, has a powerful tendency to prevent that overloaded condition of the blood to which I believe acute pneumonia to be chiefly due; still I have no doubt but that the most active preventive measure that can be adopted is keeping up the respiratory capacity to the full requirements of the system, a precaution which is specially necessary to ease-loving and high-living gentlemen who are past the prime of life. I am of the opinion that if such persons would cultivate their breathing powers by the simple means here recommended, their liability to pneumonia would be notably reduced.

THE TRUE FIRST STAGE OF CONSUMPTION.

The progress of tubercular consumption has been divided by pathologists into three stages. The first stage being that in which a deposit of tubercular matter occurs in the lung tissue, the second is entered on when the tubercles soften, and the third when they have melted down, been expectorated, and cavities have formed. But the real beginning of this most insidious and justly dreaded disease not unfrequently antedates for a long time, often for several years, the deposit of any tubercular matter. During all this time an expert examiner can detect the slight but very significant changes already taking place in the pulmonary organs. Physicians determine the condition of the lungs chiefly through the sounds elicited by percussion of the chest walls by the end of the middle finger, or a small rubber hammer adapted to the purpose, and by those produced by the respired air rushing into and out of the bronchial tubes and air vesicles. The percussion sounds yielded by the chest during what has been aptly called the pre-tubercular stage do not differ from those elicited in health, because it is only when some morbid matter exists in the lungs that the percussion note is altered, therefore negative results only are obtained in the real first stage by this mode of examination. But important information can be obtained by interrogating the sounds due to the inspired air rushing into and distending the air vesicles. When the lungs are perfectly healthy, these are breezy and almost musical. During the pre-tubercular stage they become drier and harsher; qualities of evil omen that continue to increase as time passes, if properly directed means be not adopted to correct the evil; but so far none of the symptoms that indicate the slightest deposit of tubercle can be detected, but the breathing capacity of such persons is never up to the full requirements of the system. The reader is referred to the table already given, which exhibits the decline of the breathing capacity of persons suffering from consumption in its several stages. When the disease has made such decided progress that tubercles are already deposited in the lungs in sufficient quantity to give rise to the physical signs by which their presence is proved, this carefully compiled table shows that the diminution of the vital capacity already amounts to one-third of that considered by Dr. Hutchinson to be necessary to the maintenance of health.

During the pre-tubercular stage the breathing capacity rarely falls so much as 33 per cent. below the healthy standard, but it is never up to the normal vital volume. This fact is most significant, especially when it occurs in an individual whose relatives have succumbed to this disease; but it rarely attracts sufficient attention from such persons as to induce them to have their breathing capacity measured, much less to take effective measures to bring and keep it up to the healthy standard. So long as there are, to them, no tangible symptoms of approaching mischief, and they feel fairly well, they act as if they thought "that all men were mortal but themselves." Yet it is from among persons who have an inherited but latent tendency to tubercular disease, and whose lung power is below par, that the great army of consumptives who die every year is recruited. It is very difficult to induce persons who ought to be interested in this matter to take effective measures for their future safety when the terrible symptoms accompanying the last stages of the disease often fail to shake the sufferer's confident expectation of recovery; and we sometimes see them engaged in laying plans for the future when death is imminent. I regret deeply to be obliged to make these statements, because I am convinced that if the suggestions laid down in this work were generally reduced to practice by those who have reason to dread the development of tubercular disease, many valuable lives would be saved.

THE DEVELOPMENT OF TUBERCULAR MATTER IN THE BLOOD.

During the digestive processes the starchy, saccharine, and albuminoid elements of food are dissolved, and the fatty matters are emulsified. A uniform milky solution is thus formed, which is rapidly absorbed into the general circulation; some of it passes directly through the walls of the vessels into the blood, and some is taken up by the lacteals and reaches the vital fluid by traversing the complicated series of tubes known as the absorbent system, and the numerous glands connected with it. The chief function of the starchy and fatty food elements is to keep up the physical temperature, by being submitted to oxidation in the organism; therefore it is not necessary that they should experience any vitalizing change, but are fitted to discharge their duties in

the vital domain by simply undergoing the solution that fits them for absorption. But the materials intended to enter into the composition of the body must be developed into living blood, in order to be fitted to become part and parcel of the organs by which power is evolved, and through the use of which we see, hear, feel, think, and move. This wonderful process begins and is carried forward in the absorbent system, which has been described by Dr. Carpenter as a great blood-making gland. But the vital transformation is not completed until the nutritive materials have been submitted to the action of the liver, and afterward to the influence of oxygen in the capillaries of the lungs. The food that was eaten a few hours before is thus converted into rich, scarlet arterial blood, if every part of the complex vitalizing processes has been properly conducted. But the influence of oxygen is requisite, not only to complete the vitalization of the embryo blood in the lungs, it is an absolutely essential element in every step of the vitalizing process in the absorbents.

The average quantity of food required to sustain an ordinary man in health and strength, I have previously stated, is about two pounds avoirdupois daily, and an equal weight of oxygen is necessary to the integrity of the vitalizing processes undergone by the food, and to maintain the physical temperature. When the requisite supply of oxygen is reduced, the extrication of heat within the system is promptly diminished, but the vitalization of digested food is unfavorably affected much more slowly, but with equal certainty. If the quota of oxygen existing in the arterial blood of the vessels whose duty it is to supply the vital fluid to the absorbent system, be inadequate to enable these operations to go on properly, the life-giving processes must necessarily be imperfectly accomplished. Under these circumstances the digested material is imperfectly vitalized, and is therefore inadequately fitted to be used in building up and repairing the living body. But its course in the system cannot be delayed, much less stopped.

The blood possesses a definite constitution, which cannot be materially altered without the rapid development of grave, perhaps fatal consequences. The nutritive matters received into the blood must be given up by it to the tissues for their repair, whether such materials are well or ill fitted for the vital purposes. Dr. B. W. Carpenter, of London, the celebrated physiologist, makes the following pertinent statements on this subject, which I condense from his great work on physiology: "We frequently find an imperfectly organizable product, known by the designation of tubercular matter, taking the place of the normal elements of tissue, both in the ordinary process of nutrition, and still more when inflammation is set up.

From the examination of the blood of tuberculous subjects it appears that, although the bulk of the coagulum obtained by stirring or beating is usually greater than that of healthy blood, yet this coagulum is not composed of well elaborated fibrine, for it is soft and loose, and contains an unusually large number of colorless blood corpuscles, while the red corpuscles form an abnormally small proportion of it. We can understand, therefore, that such a constant deficiency in capacity for organization must unfavorably affect the ordinary nutritive processes; and that there will be a liability to the deposit of imperfectly vitalized matter, instead of the normal elements of tissue, even without any inflammation. Such appears to be the history of the formation of tubercles in the lungs and other organs.

When it occurs as a kind of metamorphosis of the ordinary nutritive processes and in this manner, it may proceed insidiously for a long period, so that a large part of the tissue of the lungs shall be replaced by tubercular deposit without any other sign than an increasing difficulty of respiration." These views are strongly corroborated by the following facts:

In making post mortem examinations of persons who have died of consumption, tubercles of different kinds are found in the same subject; some of these, having been deposited during what is called the first stage of the disease, before the breathing powers were much impaired, bear evident traces of organization in the form of cells and fibers more or less obvious, these being sometimes almost as perfectly formed as living matter, at least on the superficial part of the deposit, which is in immediate contact with the living structures around.

This variety of tubercle has a tendency to contract and remain in the lungs without doing much injury. But as the disease progressed, and the breathing capacity progressively diminished, tubercular matter occurs, evincing less and less organization, showing a tendency to break down and cause inflammation in the surrounding lung tissue, until at last we find crude yellow tubercles that have become softened, and formed cavities almost as soon as they were deposited.

Some cases of chronic consumption pass in a few months through the various stages from the deposit of the first tubercle to a fatal termination.

The progress of the disease is determined largely by the nature of the tubercular matter at the time it is deposited.

The variety of matter which has been partially vitalized commonly exists in small quantity, has a strong tendency to maintain its semi-organized condition unchanged by time, and rarely causes inflammation.

A small or moderate quantity of this sort of tubercle exists in the lungs of many persons, in whom it produces no tangible symptoms, and who are therefore quite unconscious of its presence; and even when it does exist in sufficient quantity to develop the symptoms of lung disorder, the progress of the disease is slow, often continuing for many years. It constitutes a variety of consumption which is specially amenable to proper treatment. On the other hand, the soft, yellow, cheesy, tubercular matter, which is totally destitute of any vitality, is too often deposited in large quantities, acts on the adjacent lung tissue as an active irritant, causes inflammation, undergoes softening, forms cavities, defies treatment, and rapidly hurries the sufferers to a premature grave. These facts, taken in connection with the immunity from lung diseases enjoyed by those whose respiratory capacity is well developed and properly used, as well as the beneficial effects that are promptly secured in the favorable varieties of consumption by any important increase in the vital volume, I believe fully justify the statement that *tubercles are the results of defective nutrition directly traceable to inadequate respiratory capacity*, either congenital or acquired—in other words, tubercles are composed of particles of food which have failed to acquire sufficient life while undergoing the vital processes, because the person in whom they occur habitually breathed too little fresh air.

Persons who possess what is called the scrofulous constitution are specially liable to the occurrence of tubercular matter when their respiration is defective, or they are exposed to any other influences that favor its development in