

formed glucose, I took in every case the precaution of testing a portion of the green chlorophyllous residue with Fehling's solution before acting on the rest with acid. This was easily done by treating with weak alcohol, to which a little alcoholic potash and some Fehling's solution were added, and heating, when the whole dissolved easily, giving a green solution, which, on boiling, in no case deposited the least trace of cuprous oxide, whereas, after adding an excess of hydrochloric acid to the liquid, boiling, filtering off the insoluble products, again making alkaline and boiling, the glucose reaction took place in a marked manner.

This experiment has never in any case failed, and it would follow, if uniformly successful, that the green leaves of all plants contain a glucoside insoluble in water, but soluble in alcohol and ether. That this glucoside is, in fact, chlorophyll seems to me highly probable.

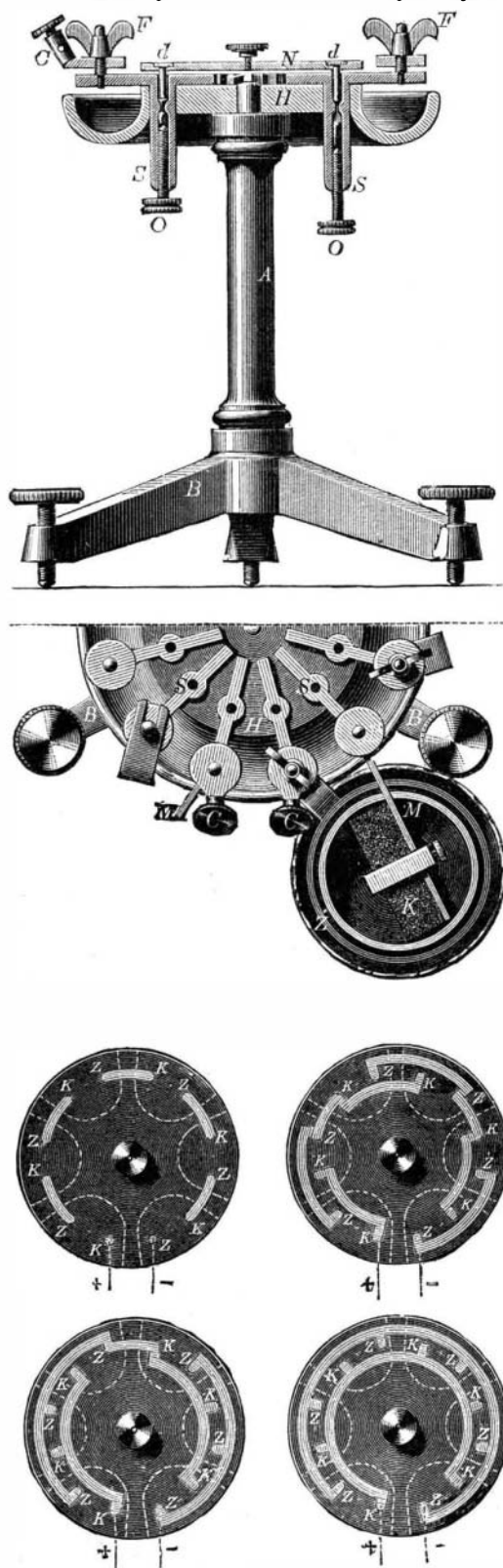
Nevertheless, absolute certainty cannot be attained, because the matter experimented on is a mixture, and it is possible that one plant out of many might give a decidedly negative result, which would upset the conclusion drawn from the rest.

Assuming, however, that the phenomena will always occur as above described, and that the reaction with Fehling's solution indicates the presence of some kind of glucose, it would follow either that chlorophyll is a glucoside, or that it is always accompanied in the vegetable cell by a glucoside of very similar properties.

I may add that I attempted to isolate the glucose or glucose-like substance formed under the circumstances described, spinach leaves being the material employed, and obtained a pale yellow gum-like substance which showed no tendency to assume a crystalline form.

DR. MATTHIESSEN'S BATTERY COUPLER.

OUR engraving represents a commutating apparatus, by means of which any number of batteries may be joined in



FIGS. 1 AND 2.—DR. MATTHIESSEN'S BATTERY COUPLER.

series, in parallel circuit, or in any desired combination. The apparatus designed by Dr. L. Matthiessen possesses the advantage that changes can be effected in very short time and without breaking the connection between individual cells.

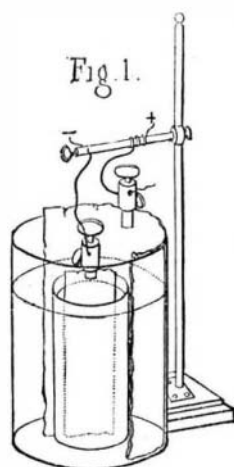
Fig. 1 shows a sectional side elevation together with a half plan. It consists of a tripod, B, provided with leveling screws, carrying a standard, A, to the top of which a plate of ebonite, H, is screwed. Into this plate twelve mercury troughs are inserted, the tops of which are extended into flat disks. Six of these troughs are connected with the zincs,

and the remaining six with the carbons by means of the movable arms, M. Besides this, two of the troughs carry binding posts, CC, to which the wires of the external circuit are attached.

The commutator disks, the platinized pins of which fit into the mercury troughs, are shown in Fig. 2. The removal of one disk and replacing of another is all that is required to effect any desired combination. The advantage derived from the use of the mercury troughs as shown, consists in the fact that the height of the mercury can be regulated by the screw, O, in such a manner as to barely touch the pin, d, thus preventing the spurring about of mercury when changing disks; and furthermore, when out of use or when being moved about, the lowering of the screws, O, allows the mercury to fall low down into the trough, where it is secure against spilling and consequent loss. Finally the mercury can be entirely and safely removed by unscrewing O entirely. The ebonite plate, H, is surrounded by a ring-shaped trough to retain any mercury which may be accidentally spilled while filling the troughs.—*Ztsch. f. Instrumentenkunde.*

FORMATION OF COLORING MATTERS BY ELECTROLYSIS.

As long ago as 1875, Mr. Goppelsroeder announced to the Industrial Society of Mulhouse that, while studying the action of the galvanic current upon organic bodies (and principally those of the aromatic series), he had observed a large number of electrolytic reactions of these bodies that demonstrated the fact that, through the electrolysis of benzol, con-

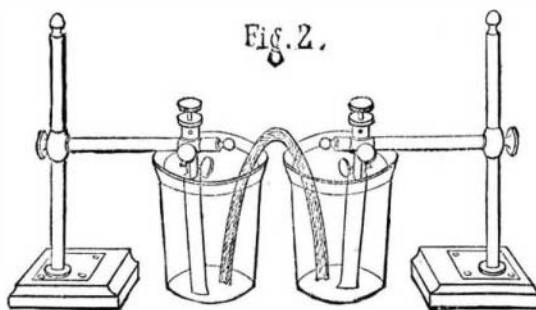


coloring matters form either at the positive or negative pole. He was persuaded that, by the use of a cheap generator of electricity, coloring matters might be cheaply manufactured by means of different bodies of the aromatic series.

Messrs. Girard & Laire have devised a process by means of which aniline blue is prepared without the use (as was formerly the case) of rosaniline. In this process the product employed is diphenylamine, which is prepared by the reaction of aniline upon its hydrochlorate. In order to convert diphenylamine into blue, it is mixed with sesquichloride of carbon, and kept at a temperature of from 160° to 180° for three or four hours.

To cite but this example, Mr. Goppelsroeder obtains the same blue by a simpler and cheaper means, and that is through the electrolysis of a solution of diphenylamine. The blue is then obtained at the positive pole.

In order to produce the current, he employs either a 16-couple bichromate of potash and sulphuric acid pile, or a Bunsen one. To prevent as much as possible the influence of one pole upon the effect of the other, he employs porous clay cylinders (such as are used in the Bunsen pile) filled with that part of the liquid which is not to furnish the principal electrolytic product, and into which is immersed the secondary electrode (Fig. 1); or else he divides the electrolytic liquid between two vessels, and leads the galvanic current from one to the other by means of Swedish filtering-paper. He also employs as a conducting medium a band of cotton wicks (Fig. 2) covered with parchment paper from



the surface of the liquid, so as to prevent the drying up of the conducting fluid. In the same way, he has used asbestos paper or card board, various textile fibers, U-shaped tubes filled with the electrolytic fluid, etc. If necessary, he increases the conductivity of the solutions by the addition of a little sulphuric or hydrochloric acid. The conducting fibers become more or less dyed during the operation—unequally and imperfectly, and principally in that portion that is situated on the side of the pole where the coloring forms. This is a fact to be noted.

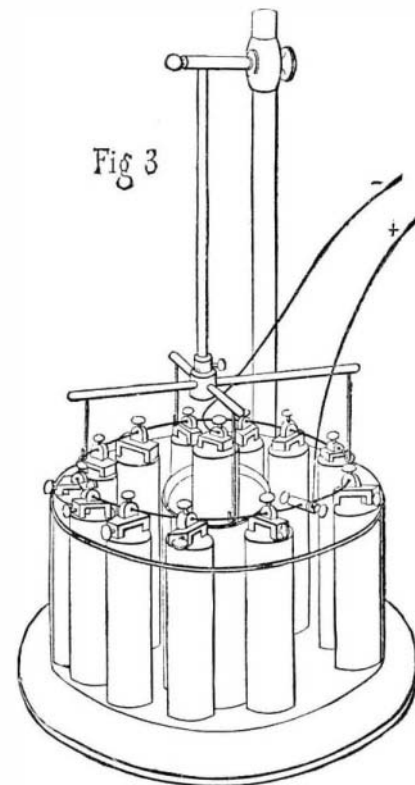
For electrodes, Mr. Goppelsroeder has used platinum or carbon, such as is employed for piles. In many cases he has had recourse to rounded carbons so arranged (Fig. 3) that the cylinder whence hydrogen is disengaged shall be in the center of a porous cylinder, while the others, whence oxygen is disengaged, are arranged around it. In this way the action of the current is stronger. Mr. Goppelsroeder has also inclosed the positive electrode in a cotton bag, and has found that in this case the precipitate does not attach itself so firmly to the platinum, and deposits between the latter and the bag. In certain cases he has employed lead, the plate of which was then wound spirally around a clay cylinder in which there was a piece of lead as a negative pole. After the operation the leaden plate was straightened out, and the precipitate detached from it by means of a brush and some water (Fig. 4).

The principal electrolyte for these metamorphoses, that is to say, the important substance that is to be decomposed by

the galvanic current, is water. The oxygen that proceeds therefrom, either in its nascent state or in the form of ozone, acts upon the bodies, which through dihydrogenation or oxidation, are to be changed into coloring matters. In this way, the salts of aniline, toluidine, diphenylamine, methyl-aniline, methyldiphenylamine, and phtol and the salts of naphthylamine are changed into coloring matters.

Thus, in the formation of aniline blue by Messrs. Girard & Laire's process, the sesquichloride of carbon causes a dihydrogenation of the diphenylamine. In Mr. Goppelsroeder's electrolytic process, oxygen in a nascent state performs such office in connection with a solution of sulphate of diphenylamine.

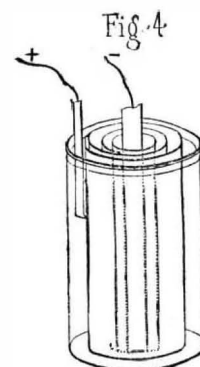
The hydrogen that is given off from the negative pole also causes some changes; with naphthylamine a curious thing



occurs, for at the positive pole there is a formation of brown alongside of violet and other coloring matters, while at the negative there is a formation of very pure violet.

In order to show that the oxidizing or dihydrogenizing action is more complicated than might be supposed, we shall recall the interesting fact discovered by Mr. Berthelot: If sulphuric acid be added to the aqueous solution in order to render the liquid a better conductor, the acid becomes changed into persulphuric acid.

As well known, in order to obtain the different colors derived from aniline, we are obliged to have recourse to chemical operations that are quite complex.



By means of simple electrolytic operations Mr. Goppelsroeder has obtained many coloring matters, among which we shall merely cite the following:

Aniline black, obtained from the electrolysis of hydrochlorate of aniline.

Pure rose, obtained from a solution of hydrochlorate of aniline with the addition of aniline and ammonia.

Very pure violet, by the electrolysis of the same solution.

Blue, obtained by the electrolysis of a solution of diphenylamine.—*Le Genie Civil.*

POPULAR FALLACIES IN REGARD TO VENTILATION.

By CHARLES R. DRYER, M.D., Prof. of Chemistry and Toxicology, Fort Wayne College of Medicine.

THE importance of educating the people as to the care and preservation of health and the rearing of children can hardly be overestimated. The work of such education devolves largely upon the physician. The neglect of this duty, though common, is not on that account more pardonable. It may be of use to call the attention of the profession to a few important points.

The first and great popular fallacy in regard to ventilation is that it needs no special attention.—This is a more serious error among the well-to-do than among the poorer classes, inasmuch as the houses of the former are more nearly air tight. With solid brick walls, double sashed windows, weather-stripped doors, and a base burning coal stove, the exclusion of pure air is carried to the utmost extent. This condition is happily somewhat relieved by the use of open coal grates. But how many fine houses does the physician enter without noticing the close, foul odor and the stifling air which come from over heating and poor ventilation? In such rooms he finds nervous, headachy women, and pale, irritable children suffering from colds the winter through. Such families need judicious instruction that respired air contains one of the most virulent poisons known, and that dry and overheated air is debilitating and irritating, leaving the mucous membranes sensitive to be inflamed by every breath of the natural atmosphere.

The second popular fallacy is that the poison of respired air is carbonic acid.—This is an example of superstition, or the "survival" in science of an idea long after it has been proved to be false. It is perpetuated in school text-books and popular treatises innumerable. Indeed, correctness of statement upon the subject is the rare exception, gross error the rule. Carbonic acid gas is no more poisonous than water; animals immersed in it die just as they do if immersed in water, and for the same reason, viz., want of oxygen. Birds have been made to live in an atmosphere containing 35-40 per cent. of pure carbonic acid and about an equal per cent. of oxygen. Yet when the carbonic acid of respired air rises to one per cent., that air is a very dangerous poison.

The solution of this puzzle is that respired air contains a very small proportion of poisonous organic matter, which is constantly exhaled from even the healthiest lungs. Its exact nature has not been determined. It is the source of the foul odor so characteristic of badly ventilated rooms. The air from the exit of pipes of a crowded hall darkens sulphuric acid, decolorizes potassium permanganate, and causes water or a sponge saturated with it to putrefy. This poisonous matter is produced in quantities proportionate to the amount of carbonic acid, hence the quantity of the latter is an indicator of the relative quantity of the power; and carbonic acid should never be allowed to accumulate in occupied rooms to the extent of seven-tenths of one per cent.

The third popular fallacy is that the most impure air accumulates near the floor of the room.—This false idea has probably arisen from the fact that carbonic acid is more than half as heavy again as air, and can be poured from one dish to another like water. Although this is true when both gases are at the same temperature, a very little difference of temperature is sufficient to reverse these conditions. Respired air issues from the nostrils at a temperature of nearly 100° F., and is lighter than the outer air at 70° or at 80°. Again, the temperature of the body is nearly 100°, usually much above that of the surrounding air. This is sufficient to create an upward current rising from the body of every person in the room, just as the heated air rises above a hot stove. If to these influences be added the more powerful action of a stove, register, or other heating apparatus, it will be understood how the impure air rises and accumulates very rapidly near the ceiling. This can be easily proved by experiment, such as placing candles at various heights.—The upper one will burn much more dimly than the lower. At the same time the cooler air on the floor moves toward the stove to enter it or to join the current rising from it.

The fourth popular fallacy is that the outlet for impure air is best placed at the top of the room and the inlet for pure air at the bottom. This may seem a contradiction to the third fallacy, but is not for several reasons. An opening into a cold place at the top of the room is often not an outlet at all, but simply allows cold air to drop down into the room. If it be an outlet, it is very wasteful of heat. The air of the room is heated at some expense and then turned out of doors as soon as possible. If the inlet be near the floor, there will be a cold draught upon the feet of the occupants of the room, and although such an arrangement may ventilate, it will be attended with such disadvantages as to render it highly objectionable. Wherever possible, there should be an outlet near the floor into a heated flue, in which the upward draught is sufficient to constantly draw the cooler air off the floor. An open fire flue is the most efficient outlet that can be devised. Instead of that, a direct draught stove in which a door above the fire may be opened answers the purpose admirably. The inlet may be for pure heated air through a register near the floor on the opposite side of the room from the outlet, or for pure cold air by an opening directed upward behind the stove and above the heads of the occupants of the room. Thus all cold draughts will be avoided, the pure cold air will mingle immediately with the impure air near the ceiling, and the room will be equally and economically warmed, and efficiently ventilated. June air may be bad in January, and the children will be as merry and rosy as the street children, who have nothing but oxygen to make them merry.—*Fort Wayne Jour. Med. Sci.*

FATTY DEGENERATION OF THE HEART—ITS DIAGNOSIS AND TREATMENT.

By CHARLES R. CRANDALL, M.D., Portland, Me.

CASE I. John B., aged fifty-four, a farmer by occupation and of temperate habits, had always enjoyed good average health up to two years before coming under observation, when he had an attack of idiopathic erysipelas, which lasted for several weeks. His recovery was slow and imperfect, and he felt that his general health had been much impaired. Three months previous to my seeing him he had what was called a "slow fever," and from this his recovery was also tedious. After these attacks he never knew what it was to be well, and he suffered more or less from the following symptoms:

He had headache much of the time and occasionally attacks of vertigo; his breath was short, and would seem to fail upon the slightest exertion or excitement; he had a constant sense of failure about his heart, and at times vague and irregular pains; he complained, besides, that he had palpitation and a sense of fluttering in the region of his heart.

He was also a great sufferer from acidity, vomited occasionally, and had a badly coated tongue. These later symptoms, accompanied by constipation, led him to believe that he was "bilious" all the time, and induced him to make frequent use of purgatives. The general surface of the skin had a shriveled look, as if nutrition and circulation were both defective. The veins about the forehead were prominent, while those of the lips were also full, giving a cyanosed appearance to those surfaces. There was a well defined *arcus senilis* upon the cornea of either eye.

The action of the heart was slow, as indicated by a pulse of sixty, and the first sound was feeble, while the second was well marked. There were, however, no valvular murmurs or lesions of any description. Upon percussion, it was found that the size of the heart was rather above normal, which I attributed to either the hard work he had done in the past or else an accumulation of fat.

The percussion note at the base of both lungs was slightly dull, which I explained on the theory of venous stasis due to impaired circulation. There were some moist rales in the larger bronchial tubes, but beyond this the lungs were in fair condition. The kidneys were normal, and the quantity of urine approximately about what should be expected. There had never been evidences of dropsy in any portion of the body.

The general condition of the patient was that of feebleness and general decline. He returned to his country home, and the termination of his case is not yet known.

CASE II. Mrs. L., a married woman aged sixty-seven, having a family grown, was large of stature, rather corpulent, and of a good history of general health up to within a few years. I was called to see her early one morning, and found that she had had several attacks of vomiting during the night, chilly sensations, more or less cough, profuse expectoration of frothy mucus, and a sense of fullness and pressure under the sternum and in the right lung. Her breathing had been rapid and difficult, and there had been a sensation in the region of the heart which she characterized as "a strange feeling" and "a weakness." I noted that her cheeks were somewhat flushed and that her lips were decidedly blue. Looking into her eyes, I detected a well defined *arcus senilis* in the cornea of each eye. Her pulse was feeble and running at the rate of about sixty-five a minute. The extremities were cool, and the flesh yielded a decided sense of flabbiness to the touch.

On auscultation of the heart, I heard a soft, feeble first sound and a fairly marked second sound. There were no cardiac murmurs or other evidences of valvular lesions. Mucous rales were abundant in the lower portion of the right lung, while the left seemed to be in a nearly normal condition. The percussion note at the base of the right lung was somewhat diminished. The temperature was normal, and there were no symptoms of inflammatory action.

I treated her for congestion of the lungs due to heart failure, and she recovered to a considerable extent in three or four days. Her convalescence, however, was slow, and she suffered much from general debility and shortness of breath. At times her breathing would be very feeble and irregular, and at other times would almost stop, and then become quite strong again. She complained a great deal of strange sensations in the region of the heart. At times there would be over-action, and again the sensation would be that of failure, as if the organ was about to stop. Moreover, she complained of coldness of her limbs, "creepy sensations" down her back, and of "tingling and numbness" in her left arm. One day she told me very confidently that at three different times during the last two years she had had "strange spells," which made her believe she was losing her mind. Each "spell" had occurred when she was out walking and had become rather tired. Upon each occasion her vision became dim, her mind confused, her breath short, and her limbs weak, and she would try to get somewhere to avert what seemed to her was impending death. So soon as she could sit down and get rested this alarming condition would pass away, and she would find herself panting for breath and her heart palpitating rapidly.

Under continuous treatment this patient has steadily improved, and has had a year of very satisfactory health.

My diagnosis in each of these cases was fatty degeneration of the heart, and it was based upon the signs and symptoms present as well as upon the general laws of the disease. But, before going into the symptomatology of this disease, let us note the meaning of fatty degeneration. As the term implies, the structure of the heart degenerates, and in time certain portions are transformed into an oily or fatty material. The initial point of degeneration is along the longitudinal fibers and within the substance of the muscle. At first the deposits of fat are microscopic in size, and appear as globules of oil or fat distributed along the fibers of the muscle. "It is usually most noticeable in the inner layers of the myocardium, which are particularly prone to fatty degeneration." With the advance of the disease the globules of fat increase in size, followed by a diminution and degeneration of the true muscular structure. In the early stages the deposits of fat may be more or less localized, but in advanced stages of the disease the entire organ may be involved. With increase of the fat the color of the organ undergoes change. Excess of fat in spots may give it a sort of mottled appearance. In advanced cases, where there is general involvement, there may be a paleness about the organ, or a "yellowish-brown, or buff, or muddy-pink color." When degeneration has gone on sufficiently far, the consistence of the organ is markedly changed; it becomes soft and yielding, and, in advanced cases, the tissue is so utterly destroyed that it will break or mash down under pressure. Such are some of the gross lesions found in a well marked case of fatty degeneration of the heart.

Returning now to a consideration of the causes and symptoms of the disease, I will say that in both of my cases the age of the patient was sufficiently great to assign it as a predisposing cause. Fatty degeneration of the heart is most common between the ages of fifty and seventy. Watson teaches that it is most common at about the sixty-third year. Of eighty-eight cases collected and analyzed by Hayden, the larger number were between the ages of sixty and seventy.

Obesity is considered to be another predisposing cause. While it is not a cause upon which much stress can be laid, nevertheless, as my female patient was corpulent and flabby, I accepted that condition as a predisposition to the disease from which I believed she was suffering. Thus both patients had predisposing conditions which would naturally form powerful factors in diagnosing fatty degeneration. Both had indistinct first heart sounds, accompanied by a generally weak and irregular condition of the entire organ. Nearly all authorities lay much stress upon these physical signs when accompanied by the other general symptoms of fatty degeneration.

In regard to this point Da Costa has said: "We may, however, suspect it [fatty degeneration] if the signs of weak action of the heart—feeble impulse and ill-defined sounds—coexist with a pulse permanently slow or permanently frequent and irregular, and be met with in a person who is the subject of a wasting disease, or who has arrived at a time of life at which all the organs are prone to undergo decay. Something more than a suspicion is warranted if, in addition, there be proof of fatty degeneration elsewhere, such as an *arcus senilis*."

An important symptom at times in both cases was irregular, rapid, and difficult breathing, which we attributed to heart failure. This symptom would naturally enough be present with a feeble heart, because the circulation through the lungs must necessarily be slow, rendering the condition most favorable to venous stasis. In case second the irregular breathing was at times of the peculiar kind known as "Cheyne-Stokes dyspnea," or "the ascending and descending respiration." So common is this form of dyspnea in fatty degeneration of the heart that it was for a long time considered characteristic of the disease; but at present it is only admitted as corroborative evidence when found associated with other well marked symptoms. As before intimated, the second patient had at times a tendency to syncope, which is a condition more or less associated with a fatty heart. The remarks of two eminent authorities on this symptom are especially worthy of citation, for they tend to explain in some degree why it is that elderly people often have "fainting spells," or have attacks which they dread as

being precursors of apoplexy. Da Costa says that these patients may be "subject to seizures during which their respiration seems to come to a standstill; and that they are liable to be stricken down with repeated attacks having the character of apoplexy, save that they are not followed by paralysis." And Flint directs our attention to the fact by observing that "these patients are liable to seizures resembling apoplexy, characterized by temporary loss of consciousness, without paralysis, the surface being pallid and cool and the circulation feeble."

Both patients had well marked *arcus senilis*. The presence of the senile arc is not given the diagnostic importance it formerly was, but, when found in elderly persons in connection with the other symptoms herein referred to, it is worthy of consideration. It usually points to degenerative changes, but modern investigation has overthrown the view that it has a pathognomonic relation to fatty degeneration of the heart. It is now believed that it may occur either with or without the degeneration of the heart.

Again, both patients suffered from indigestion and what they characterized as "biliousness." This is another common symptom belonging to the group of those having a diagnostic importance. It is believed to be due to impaired circulation resulting in secondary congestion of the stomach and liver. After this state exists for a time it causes a catarrhal condition of the mucous surfaces of the organs of digestion, and there result acidity, pyrosis, flatulence, and other well marked symptoms of indigestion.

Lastly, both patients complained of pain and other strange sensations occurring in the region of the heart. In many of the cases of fatty degeneration of the heart, patients will complain of a "peculiar feeling" of "some pain and fluttering," of "a queer feeling," of "a sense of weakness or failure," or "a sense of suffocation." Others will add also that they have a sense of fullness under the sternum, pain and numbness in the arms, and "cold and creepy feelings" down their backs. These symptoms are often encountered in elderly people, and they should always be taken as suggestive of dangerous disturbance in the heart and circulation. While it may be said that there are no one or two symptoms that are pathognomonic of a fatty heart, when one comes upon a group like the foregoing occurring in an old person, there seems but little room left for doubt.

But few words are required regarding the prognosis. In one sense it is always unfavorable, while in another it is often made favorable by regulated habits and medical treatment, which aid greatly in prolonging life. But the rule is, that, as years increase, patients thus afflicted become feeble and steadily fail. At times they sink from intercurrent disease or wear out from difficult breathing, dropsy, and debility. Again, they die suddenly from cardiac syncope or else from rupture of the heart.

Of eighty-three cases of fatty disease of the heart, collected by Quain, sixty-eight died suddenly."

The treatment indicated is worthy of consideration, for, if well carried out, a valuable life may be decidedly prolonged.

1. Treatment should be supporting. Everything should be done to preserve muscular integrity and maintain vitality. Proper exercise, good food, fresh air, plenty of sleep, tonics and stimulants, make up the daily requirements.
2. Moderation in all things is a law that must be enforced. The penalty of its violation is rapid decline, constant distress, perhaps sudden death. Whatever exertion taxes the strength, causes mental excitement, or wears the nervous system may cause failure or a rupture of the cardiac walls.
3. These patients must not be housed up, for they need the vitalizing effects of pure air, sunshine, and gentle exercise. These can be best obtained by short, easy walks and daily rides in an easy carriage. When seeking out of door life, exposure to cold and damp or excessive heat must be guarded against, for whatever disturbs the circulation, or prostrates, will imperil the diseased heart.
4. The diet should be nutritious and easily digested. Of the articles most appropriate may be mentioned skimmed milk, tender fresh meats, fruits, Graham or gluten bread. These are wholesome blood and muscle making foods, and have no special tendency to make fat.
5. Stimulants under such conditions are to be given judiciously, but nearly all these patients need them more or less. General debility and a feeble heart make a permanent demand for a mild stimulant which will help promote digestion and sustain the vital powers. In case second I found that a small quantity of sherry wine taken four times daily seemed of the highest utility in maintaining the force and regularity of the heart's action.
6. In regard to general indications for treatment, there is much to be looked after, for these patients generally suffer from shortness of breath, poor appetite, indigestion, anæmia, attacks of syncope, and headache. Hence there is the constant demand for strychnine, digitalis, caffeine, opium, iron, and quinine. These, together with wine and a regulated diet, will do much toward prolonging life.—*N. Y. Med. Journal.*

MALADY FROM VANILLA.

THE interesting investigations made by Dr. Layet, of Bordeaux, are thought to satisfactorily explain the nature of certain injurious properties of vanilla. The affections have been studied at a warehouse in Bordeaux, where on an average 25,000 to 30,000 kilogrammes of vanilla arrive every year. In these storehouses the pods are cleansed, and sorted according to quality—manipulations which seem to cause certain symptoms among the operatives. At first an itching of the face and hands associated with a powerful smarting sensation is experienced, and the skin becomes covered by a pruriginous eruption, swells, reddens, and desquamates at the end of some days; at other times there is a feeling of malaise with dullness, stiffness, and muscular pains, necessitating a cessation of labor. The cutaneous malady seems to be due to an acarus which appears as a small, white, rounded body, occupying generally the ends of the pod, and determines the affection by its mere contact. The nervous symptoms, M. Layet thinks, may be caused by inferior pods containing much oily juice.

To prevent the cracking of the glass tubes that are connected with steam-boilers to show the height of the water within, and which is of a more or less frequent occurrence, as the tube is of a high temperature inside and a cold current can strike them from the outside, the *Industrie Blatter* recommends the use of two glass tubes, one within the other. The air that is confined between the two serves as a protection to the inner tube against outside cold, and the outer one against the high temperature of the inner one. Both tubes are packed in brass couplings, and form one single instrument.