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THE LIVER.

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I promised to talk to you this evening on a subject which lies very near to every man's heart,-- the liver. The liver is nearer to the heart than almost any other organ of the body. I think many people suffer from having too much liver on the brain, without realizing the closeness of the liver to the heart. There are a number of people suffering from chronic diseases, who complain of their livers when their livers are not to blame. There was a gentleman complained to me the other day of a terrible pain he had in his liver, indicating the location of his liver on the left side. His liver and heart seemed to be transposed,-- and such a thing is possible. A lady patient of mine some time ago located her liver on the left side and her heart on the right side.

The liver is perhaps one of the most interesting organs of the body; next to the brain it does the most interesting and important things. It is composed of glands, and is itself a gland. The liver ordinarily weighs about three and a half pounds; sometimes it weighs much more than that. I once saw a liver that weighed twenty-eight pounds; it was about eight or nine times as large as it should be. The liver, as I said, is a gland, and it secretes bile. But there are many things that the liver does besides secreting bile. Many peole imagine that the sole business of the liver o is to make bile, but it does more than that. I will tell you a little about the liver; in the first place it is a bilemaker. Bile is a sort of lye. The liver is s sort of leach barrel. You remember the old fashioned leach barrel behind the house where our mothers and grandmothers got ready for soap making day? When I was a boy, I used to tend the leach barrel and supply it with water and it seemed the most thirsty leach barrel in the world.

and I didn't like it because I had to carry water some ten rods to supply it. Well, the liver leaches out of the blood all alkaline residue of the food. When food is burned in the body some of it goes off in smoke through the lungs, and the ashes go& into the liver which makes bile. If you put a piece of wood into fluid it will float, it will not dissolve; but if you put a piece of wood into the stove and burn it, it will dissolve,-- some of it goes into the chimney in the form of smoke and some of it dissolves into ashes and it will not dissolve until it is burned. So the apples and potatoes will not dissolve until they are burned; when they are burned they become completely soluble, some portion going off in the form of gas through the lungs and the skin,-- and that is the greater part-- and some of it goes off in the liver and kidneys in the form of ashes.

This function of the liver is important, because it carries from the body highly toxic substances.

Bouchard, the eminent French physiologist pointed out, a number of years ago, the fact that the body is a"factory of poisons." If you should put a sheet iron stove in a room you shwould-seen-be-driven-out-of-the--room-- and burn wood or coke in it, if there was no means for it to escape from the room, you would soon be driven out of the room or would be asphyxiated. The same thing happens in the body when food is taken, as happens to the fuel put in the stove,-- and food is dissolved by the slow process of burning called oxidation. The same process takes place in plants and trees when they die. When a tree falls down, it gradually decays, and it does so because it oxidizes, producing heat,-- and it produces just as much heat in rotting on the ground as it does in the furnace. So the food in the body produces just as much heat,-- and a little more energy to work than if it were burned in a steam engine. The same thing happens to food, burned or oxidized in the bodythat would have happened to the food if it had been

used as fuel in a furnace, engine, or locomotive.

In this process of combustion, a portion of the food escapes in the form of poisons-- carbonic acid gas, etc. Smoke which escapes from the body is poison, and would asphyxiate those who inhale it, whether animal or a human being. Plants would thrive upon it, because they feed upon carbonic acid gas and other poisons, and it does not asphyxiate them. Lye is poison so the bile is a lye and is poisonous. The breath and the secretions of the skin are poisonous, but the most poisonous thing of all is the bile. But this bile carries off something besides poisonous substances; it carries off in these substances all alkaline wastes, among which are blood corpuscles. All the blood corpuscles of the body die every six weeks, so we have a new supply of blood every six weeks. People sometimes think they must do something every spring to purify the blood; but they do not have to do it. Lord Bacon used to say that we should be bled every spring so as to get a new supply of fresh blood, so he had himself bled every spring and had as much blood taken away as he could stand,-- and he would sometimes faint away from the loss of blood, but he insisted on it, so that he might have an entirely new supply of blood. Now we do not have to do that for we get a new supply of blood every six weeks, and all we have to do is to take plenty of good, new, fresh food, and take plenty of pure water; in this manner we can secure pure, new blood every six weeks.

What becomes of the old blood? I will tell you something about that: the liver is a sort of rendering establishment,-- it takes the old blood and grinds it up and makes lye out of the ashes in the blood, and it takes the red coloring matter out of the red corpuscles for the purpose of coloring the hair, etc. Perhaps you have never thought where dye comes from, by which hair is colored-- red, auburn, brown or flaxen; it is colored by the dye stuff saved out of the red corpuscles by the liver.

There is another very interesting thing that the liver does: it takes out of the blood corpuscles a distinctive ferment or principle which is necessary for certain processes in the body,-- the liver saves it out of the blood. When a horse dies in Chicago they take him to a rendering establishment and make leather out of his skin, fertilizers out of his bones, and calf's foot jelly out of his hoofs, and they make oleomargarine butter out of his fat,-- and they make coffee out of his liver ("Oh"). Not long ago the "Sanitary Journal", of England, published an analysis of some coffee which was adulterated, and which was found to be composed largely of ground up horses' liver; the liver was brown enough for the coffee, and the alkali was poison enough for the coffee. This is an easy way to dispose of the horse. The liver is a great economist. You would not find any where else in nature such an economist as the liver. The liver takes all the dead corpuscles of which there are millions and millions and millions, that die every day,-- there are more of them that die every second than there are inhabitants on the face of the earth. Five million corpuscles can live in the smallest drop of blood that can hang on the point of a pin. There are twelve to fourteen pounds of blood in the body, and you can figure up from this how many there are in the body. There are so many of these corpuscles that there are some hundreds of square yards of blood which contain them, if they were spread out. It is a wonderful thing that we are able to produce so many of them, and we are able to take care of such a vast number of dead ones, as are dying every second. The liver catches them up when they die, it grinds them up and makes a distinctive ferment out of them; it takes out of these dead corpuscles coloring matter for the eyes,- in the eyes we have a dark chamber-- a sort of camera obscura, where the picture is made by the bleaching out of some of the color of the curtain in the back part of the eye. A photographer's pictures are printed by the oxidation of nitrate of silver-- the silver is oxidized and turned —

brown. But in the eye, it is just the opposite of the photographer's process,-- there is a dark brown curtain at the back of the eye, and a portion of this is bleached out white, which is like the negative of the picture. In order that the curtain shall be ready for use, the coloring matter must be reproduced continually, and where the bleaching out is taking place, some new coloring matter must be put in its place, and this "dye-stuff" is made by the liver for this purpose right along.

Now what does the mother and grandmother do with the lye from the leach barrel. She mixes it up with the soap grease and makes soft soap. This is what the liver does; it takes alkali out of the dead blood corpuscles and makes lye or bile and sends it down into the small intestines and there it combines with the fat of meat of other foods containing fat which we have swallowed,-- this is combined with bile and makes a little soap by which the fat is dissolved. If hhis were not done, we would have great inconvenience in disposing of the food stuffs which we have eaten and which contain fats,-- because the fats do not dissolve in water. You smear your hands with oil and you wash them and there is an undissolvedportion left in the water. Sometimes when you have been eating highly seasoned vegetables such as "Saratoga chips", and other greasy foods, the inside of the stomach is in the same condition as were your hands, and the intestines would also be in the same condition if it were not for the fact that bile comes down and frees them from it. What do you do with your hands whmn they are covered with grease. This is what the bile does,-- it makes a little soap, combines with the fat and breaks it up into very small particles-- so small that they cannot be seen by the naked eye. Milk is composed of minute particles suspended in solution, and these particles are seized upon by the digestive ferments formed by the bile, slowly decomposed and then pushed into the blood. If it were not for this process we could not dispose of the fats,

in our food, and they could not get into the blood. (Illustrating by diagram). Suppose this is a blood vessel. Here is the intestine and here are some small particles of fat in the intestine. Here is the blood and here are the cells. Here is a layer of cells-- there are many of these. Here are only two here, however, between the intestines and the blood bvessels on this side (this is for the convenience in the diagram). Here is a stream of blood. When these little particles of fat comein contact with these cells they are slowly dissolved and passed along and pushed into the blood. This is the way the fat is disposed of, and if it were not for the bile, this could not be done.

Now the bile does something more than I have stated: It lubricates the small intestines and aids in absorption of fat. If it were not for the bile absorption would not take place readily.

Another important thing that bile does is to neutralize the acidity of the gastric juice when its work is done in the stomach, so that, notwithstanding the presence of gastric juice the stomach is not digested by it- the gastric juice dissolves and digests every thing except the stomach itself,-- and why does it not digest the stomach? Nobody can tell why; but this thing we know, and that is, that after the gastric juice has done its work in the stomach, the food passes into the small intestines, and the gastric juice would digest the small intestines also if it were not for the fadt that bile is poured down at the same time that it passes into the small intestine,-- the liver pours down the alkaline bile at the same time and neutralizes the acidity of the gastric juice, and so the small intestines are not digested.

Besides these things the bile is a natural laxative. It stimulates the small intestines,-- it is like jerking a rope at one end and sending down a wave of motion, and then jerking it up lower down and sending the wave

further along, thus keeping the waves of motion going clear down the whole length of the rope . This is what the stomach does,-- it pours down bile into the small intestines of which there about twenty-five feet, the food being moved down from the stomach into the small intestines. The food is only partially digested in the stomach; the stomach is only an antechambef,-- a lower passage way into the intestines-- it is the first resovoir of food, and the small intestines are the second, the food being absrobed at the lower end of the colon, the small intestines carrying the food from the stomach to the colon. It is necessary for the food to be transmitted along the intestines, and so the bile comes down upon the intestines just below the stomach at the same time giving them a stimulating onward movement. The stomach dumps itself into the small intestines three and one-half hours after the food is eaten. The food is then seized upon and squeezed dry by the muscles of the stomach and forced down into the small intestines; if it were left in the stomach after that time it might make trouble, but the liver sends down bile enough to make the intestines jerk and squirm like the end of a worm, and it seizes the food and passes it along. Pretty soon a little more bile comes down and gives the intestines another jerk, and so on. It is like jerking a rope-- and in this manner the food is passed along by successive movements of the intestines to the colon. So the bile is a very useful and essential fluid in the work of digestion.

A few more words about what the liver does: it grinds up the food and converts the alkaline wastes into bile,-- but it does more than that: after the sugar has been absorbed into the blood, the liver takes all the sugar out of the blood and stores them up in the stomach. Sugar has a tendency to shrivel things up. Fruits shrivel up when placed in sirup; strawberries shrivel up when they are canned in sirup. So when too much sugar enters the blood it shrivels up the red corpuscles. You can verify this in

the case of sugar and fruit by the aid of a microscope. The same thing would happen if too much sugar were present in the blood. So to prevent the presence of an excess of sugar in the blood the liver seizes it and stores it up in the blood itself, and then doles it out to the body as needed. The liver converts the sugar into glycogen and stores it up in itself. It is for this reason that after dinner the liver is larger than before dinner. You cannot feel the liver before dinner as it is then below the lower border of the ribs, but it is so low that you can feel it down here after dinner; and sometimes after a Thanksgiving or a Christmas festival, the liver goes further down, and sometimes this is repeated to such an extent that the liver keeps enlarging all the time.

It is very important that the liver should store up sugar in this way, because it thus provides for a sort of automatic stoking arrangement by which fuel of the body is supplied as needed. You have heard of the automatic stokers which supply coal to boilers as fast as needed. This is what the liver does for the body, giving up sugar, which is the fuel of the body, as fast as the furnace of the body needs it. This fuel generates as much heat as would be done by so much candle (illustrating) and about one-fourth more is burned in the body. If the liver did not retain the sugar, the temperature of the body might come up as high as 150 fifteen degrees by the digestion of so much fuel-- it might come up to the boiling point. If it were not for the fact that the liver retains in itself the sugar and thus restrains the fires of the body we might be parboiled or roasted by the fires of the body. So the liver is a very important regulator of heat. What does the liver do with the sugar after it takes it out of the blood? It converts the sugar into glycogen. Again it is converted into suger by the ferments which the liver makes. Where does the liver get this ferment? From the pancreatic juice; it gets into the blood, and the liver takes it out of the

blood and utilizes it in the digestion of starch, and converts it into sugar. The liver also capturds the poisons found in the blood. Many times because of neglect to provide proper arrangements for the pure supply of water, lead pipes poison the water used for drinking purposes and at length causes colic; you do not get colic the first thing after drinking this contaminated water-- you do not get lead paralysis the first thing; you can drink that watdr for a long time without apparent trouble,-- and why? Because the liver stores up the lead; when the liver finds lead in the blood, it stores up the lead in itself. It goes on doing its work until it gets all the lead it can hold and then the lead poison runs over into the blood and contaminates the body. The same thing happens in the case of arsenic on wall paper, the result being bilious attacks, etc. after the liver has been nearly overwhelmed with poisons. When this is the case it is very common for people to take calomel or blue mass. The liver stores up as much of this as possible, but by and by your gums begin to get sdre, and you get salivated; this is because the liver has stored up all the calomel and mercury it can hold and the remainder has been running over into the blood and the body has vbeen poisoned. So when people take minerals-- iron, for instance-- for their blood, the liver absorbes it until it is overwhelmed with it and then it poisons the system,-- and it is the same with all mineral drugs. So with the use of alcohol,-- its effect is gradual. The liver is a shut door to keep the poisons out of the body. All the poisonous substances which are absorbed must pass though the liver,-- it is a Pasteur filter through which the fluids must pass; before these fluids can get into the rest of the body every one must go through the liver. If it were not for that fact, every man who chews tobacco might be killed right away,-- it might be his death warrant. But the liver detroys nicotine and relieves the body of it as long as it can, but after a while when one smokes cigars for a long time, he becomes so saturated with nicotine that it hangs on his breath-- you

can smell tobacco hours and hours after he has smoked-- the nicotine hangs on his breath. What does this mean? This means that he has, himself, become a cigar- he is soaked full of nicotine,-- his liver is full of it, and it has escaped from his liver into his blood and has been carried to the rest of the body by it, and his whole system has become soaked with nicotine, he is a cigar, and now he has gotten where he cannot get very much further, and he is going to suffer pretty soon from "tobacco heart", and pretty soon he will suffer from tobacco amaurosis, a very marked symptom of tobacco poisoning. A man will be protected from these poisons so long as his liver has room to store them up, but, as I said, when the body gets full of them they run over and contaminate the system. This rule applies to tea and coffee as well as to other poisonous drugs. (I notice that some of the ladies are becoming interested now). You can drink you extra cup of tea and coffee for some time without feeling any apparent bad effects from it because the poison is disposed of as long as possible by the liver. So long as the liver burns up the caffein and thein of these drugs you can take them without apparent harm. A man once said to me when I spoke to him about tobacco doing him harm, "I have been smoking cigars for twenty years and I do not see that they have injured me any, and why should they injure me now?" The reason that it is so injurious now is that the liver can store up no more nicotine. The same principle applies to a man who drinks alcohol. A poor fellow in Chicago who had been in the habit of drinking intoxicating liquors, complained to me that it required only a little alcohol to make him drunk, although he used to take big drinks without getting drunk. The reason of this is that his liver has lost its power to store up alcohol. This is the most remarkable function of the liver-- that it is able to store up sugar, mercury, lead, alcohol, and all other poisons.

There is another thing that the liver does, which is very remarka-

ble and very useful,-- and that is to destroy certain poisons found in the body. There are certain poisons formedin the body all the time and they are largely formed by fermentations produced by germs. There are certain germs in the alimentary canal known as the bacillus coli communis,-- the colon bacillus. This germ is generally found in the barnyard, in the manure heap, and also in milk. These germs are found in the blood of all warm blooded animals and are producing poisons in large quantities all the time, and this colon bacillus is all the time producing deadly poisons and when these poisons prevade the system we grow old,- and this is the reason we do grow old. The liver destroys these poisons for a time, by by and by through continual overwork, the liver gets worn out and not able to destroy these poisons as fast as they are formed, and then disease does its mischievous work. I felt a lady's pulse the other day and it was as hard as whip-cord-- it was just like a hard cord, instead of being as it should have been, soft like a little silken tube,-- it was more like a rubber tube. I said to the lady, "I do not want you tell me who old you are because your pulse tells me that." "Well", said she, "how old am I?" "You are eighty years old". "Oh, no, I am not eighty years old-- I am not sixty years old yet". I said, "Your pulse says that you are eighty years old, your arteries show that you are eighty years old, and we have good outhority for saying that,'a man is as old as his arteries.'" If your arteries are old you are old, and they show that you are old, and youare going to die pretty soon. You are pretty close to the end of life if you have hard arteries, because the arteries circulate the blood. The blood is the life, and when the arteries wither away there is no room for the circulation of the blood through the various parts of the body, and the blood which is the life can no longer communicate life to the body and the body must die. This is the cause of apoplexy, also of senile gangrene. This is the reason an old man is smaller than he used to

be,-- his liver and other organs shrivel up; he loses his power to make gastric juice and hence he has poor digestion. This is because of the failure of the arteries to supply blood to the body,-- and this causes old age. Germs are always present in the form of poisons in the body and they are not disposed of when the liver is infirm and disabled, and so they do their mischievous work in hardening the arteries and bringing on premature old age. So if you do not want to be old you must take care of your liver. Someone once asked Henry Ward Beecher what was the secret of long life, and he said "That depends upon the liver", this is true-- it depends upon the liver as well as they way in which a man lives. If a man's liver is bad, his life is hardly worth living. I was once introduced to Mr. Beecher and he asked me to tell him something about his health,-- this was about three years before he died. He said to me, "Doctor, there is, somehow, a strange melancholy that sometimes comes over me, and I feel as though I did not care whether I lived or not; I do not seem to take much interest in life. Still I feel as though I have had as much success as most men have, and yet I sometimes feel as though I did not care much about this world and I do not understand it". I said to him, "I think there must be something the matter with your stomach and liver." "Oh, no", he said, "my stomach and liver are all right." I then looked at his tongue, and it looked as though it ought to have been taken charge of by the city scavenger. His stomach and liver were foul and filled with poisons. Mr. Beecher died soon after that. He died of old age, and he was growing old when I spoke to him, because his liver has ceased to protect his body against the poisons normally generated in the bodies of men-- I mean in their depraved state — --for I believe there was a time in the pristine days of the race when there was no colon bacillus. A child has no colon bacillus; it gets it after it has grown up and its body has become deteriorated and depreciated; the colon

bacillus then gets into the liver, lungs, and tissues, getting into the appendix vermiformis causing appendicitis, abuses of the liver, and a variety of other troubles. As I said, I believe that there was a time when this colon bacillus could not live in hthe human body. This was in the days when people lived nearly a thousand years. If the colon bacillus could only bé cast out of the alimentary canal, I do not know why a man could not live a thousand years to-day just as well as he could a thousand years ago, for it is the colon bacillus that kills people. Prof. Boix, of Paris, some years ago injected some of this colon bacillus into rabbits and their livers shriveled up and lost their power to destroy germs, poisons. so I think this fact has proven the demonstration,-- the fact that I have been telling you and which I have been advocating for many years,-- that the colon bacillus was the real cause of old age, by producing degeneracy of the arteries after the liver has lost its power to destroy and dispose of the poisons produced by them. So it is important to keep the liver intactso that it will be able to resist these deadly poisons.

I must tell you of another poison which is destroyed by the liver,-- and this is a natural poison produced in the body. There are some poisons, however, introduced into the body which are not natural poisons, through the use of such things as mustard, pepper, pepper sauce, etc., which destroy the liver. Boix found that pepper had six times the power of alcohol to cause "gin liver". Here is a picture (referring to chart) of what is called "gin liver". Here is a cirrhotic liver. Notice these lumps and nodules which make the liver look like the sole of and English cartman's shoe which is covered ewith"hob nails" so that such a liver is sometimes called "hob-nailed liver". Prof. Boix found that pepper, peppersauce, and similar articles had six times the power of alcohol to produce this effect upon the liver, because they so quickly overwhelmed the liver with poisons. These are poi-

sons which are taken in from the outside. But there is another poison that is found in flesh foods. When a person eats meat that has been slaughter ed so long that it has a "haut gout"--"high flavor" because the flesh has already commenced to decompose, the liver is particularly taxed. This high flavor is due to the presence of germs which produce decomposition and decay. These poisons are taken into the stomach with the meat and so on, and are carried to the liver, and the liver has to deal with them just as it deals with alcohol, mustard, pepper, tobacco, nicotine, and all other poisons which are taken into the system and enter the circulation.

I recently read in the Medical Journal of a man who once desrtibed his dinner as being a spledid one as it left a fine,rich, brown taste in his mouth in the morning. Why does a person have that taste in his mouth in the morning? It is because his liver has been tired out and overwhelmed by this addition to its work, and the poisons which should have been carried out of the body are left to accumulate in the body. By the Salisbury dietary these germs are introduced into the stomach in abundance and that causes this rusty taste, so to speak, in the mouth, because they have developed and grown in the stomach like the mold on the wall. I once told a man whose tongue was in this condition, "If you should take some of this mold on your tongue and plant it on a potato which has been boiled, it will produce the same kind of mold as has been growingpn you tongue." He said he did not believe it. I told him I could scrape off a portion of it and plant it on a boiled potato and it would produce the same growth as the mold on the wall,-- and I did so, taking the least little bit from his tongue with s stylet and the mold on the potato had not only the same appearance but the same odor as the mold on the wall, because it was produced by the same germ.

The poisons which have been taken into the body in this manner must be

disposed of by the liver. When a person eats a dinner of Welsh rarebit, old cheese, meat with a "haut gout" etc?, and macaroni a l' Italien, Limburger, Switzer, or something of that kind-- when one has put such things into his stomach, the consequence is that he is filling his blood with these poisons, the same germ found in cheese;- and this cheese is really rotting. If you should boil milk so as to sterilize it and kill every germ in it, you could not make cheese of of this milk. The making of cheese depends upon the action of germs of the barnyard, pigsty, or chicken-coop, germs which have dropped into the milk from the cow, etc. Now I am not giving you a mere picturesque statement of these things,-- I am telling you what the cheesemakers know to be true. They sterilize their milk, killing every germ in it, and they then put in such germs as their customers require,-- and this they can do for they have a regular assortment of germs--barnyard, chicken-coop, and other germs. A man once wished to make a certain kind of cheese and he went to a cheese factory in France where this cheese was made and he found everything covered with green mold; he took some of this mold home; planted it, and soon he had some of the same kind of mold and made the same kind of cheese and it was reckoned as good as any cheese that was made in France.

people do not think when they swallow these poisonous things that the liver must take them out. The liver is the most abused organ of the body; frequently it is like a poor, tired, overworked donkey, and it is treated in the same manner when you put into it such things as the oyster who feeds on the slime and ooz of the ocean. And when your liver gets overworked, weary, and slow, you ask your doctor for something to stir it up, and when this is done, it is like putting the lash to the poor donkey whom you have already overloaded with sand bags and other things, and you put on the whip until he falls to the ground. So when the liver has been abused in the same

manner it is likely to be abused-- you may have jaundice, or a chill, or you may have gall stones, or abscess of the liver, or the liver may fail up altogether. The liver is the most self-sacrificing organ of the body and suffers the greatest abuses. It is a tough organ, having more vitality than any other organ of the body. A German investigator once cut off half the liver of a rabbit and it grew in again. Then he cut off the other half and that grew in again, so the rabbit had a brand new liver-- and that is just what you want.

The liver is all the time being reconstructed by the process of growth, but you must take care of your liver if you would be well and happy, because it is the liver that makes the blood pure. We talk about "good spirits" without thinking how much our good spirits depend upon the condition of the liver. The ancients must have understood this matter for they spoke of the despondent, melancholy person as being a "hypochroudiac", which means in Greek, "down under the liver", and is what we usually term, "down in the mouth", and this is practically the same thing as is being done in the liver or stomach, for when a man feels melancholy or despondent the corners of his mouth are drawn down. It is said there was a famous Italian wit in the days of the celebrated Dr. Abernethy, who was once in a terrible despondent and downcast dondition, notwithstanding he was at the same time convulsing great grouds with his wit. His trouble was so great that he went to Dr. Abernethy for assistance. After he had stated his condition the old Dr. Advised him to go and hear Grimaldi. "Ala", siad he, "I am Grimaldi". If the doctor had only told the patient to stop eating English roast beef, and lived on fruit for a week or two and discard all his condiments, etc., and given his liver an easy time, his liver would have done its work well he would have been happy and his spirits would have quickly arisen.

Here is a microscope and some specimens by the aid of which you

may form some idea of the work of the liver. Here are the liver cells. If you look sharp here you may see some little brown specks. These are liver cells and I hope you will examine them carefully. Here are a couple of young men who will explain them to you. Here you see how the cells are arranged in rows; from this point where the blood comes in for purification.

Now I must let you go, with the earnest hope that you will take good care of your livers.

Americans are proverbially a dyspeptic race, with a few exceptions now and then among city aldermen, plethoric judges, and doctors who do a consulting practice, the total number of whom is not sufficient, however, to bring the average up to the normal standard. Leanness is due to the inability to digest and assimilate fat-making food. The non-digestion of starch is unquestionably one of the most common causes of disordered digestion. This is doubtless the chief cause of the extensive use of beef and other forms of flesh food in this country. Meat is readily dissolved in the stomach, and its digestion is not accompanied bu the flatulence, acidity, and other distressing symptoms present in amylaceous dydpepsia. A beef diet is the most ready means of obtaining relief from these annoying symptoms and hence is one of the most common diet prescriptions made by physicians, and one which is perhaps more frequently than any other made use of by patients for themselves. The result is relief from a certain set of symptoms, but at the same time the developement of others which, if less disagreeable, are in the end not less serious. An exclusive meat diet robs the system of its proper supply of fat, and overwhelms the body with a great quantity ptomains, leucomains, and tissue-poisons, which decrease the resistance of the body to disease.

Bouchard, Rogers, and others have shown that the poison-destroying function of the liver depends upon the amount of glycogen which it contains. This is almost exclusively derived from the starch of farinaceous foods; hence a person who, in consequence of inability to digest starch, confines himself largely to a meat diet, is exposed to a double injury,--the introduction of toxic substances into the system, and the lessened ability to destroy toxins and ptomains.

The dyspeptic who is suffering from the inability to digest starch/ in exchanging a farinaceous for a flesh diet, simply exchanges one class of morbid conditions for another, the biliousness, or general toxemia, the uric

acid diathesis, and the resulting rheumatism, neurasthenia, and allied conditions which proceed from a meat diet, being far more serious in their ultimate effects than the acidity, flatulence, and other annoying symptoms experienced from the indigestion of starch. The fermentation of proteids in the stomach, intestines, and colon, which always accompanies a flesh diet, produces toxic substances of a peculiar character, while the fermentation of starch results in the formation of acids and gases which are annoying and irritating, but not to any degree toxic. A certain amount of fat in the tissues is necesary as an aid to vital resistance. The excessively lean as well as the overfat person is more liable to attacks of disease that the person who possesses a normal amount of adipose tissue. Starved pigeons can be readily infected with certain microbial maladies against which they are found to be proof when well fed.

The substitution of a meat diet for one consisting of farinaceous foods, while a convenient mode of dissipating certain unpleasant symptoms, is, nevertheless, not the best remedy for this condition. What the patient requires is not the withdrawal of starchy foods, but the ability to digest them. In extreme cases, starch may be temporarily administered in a digested state, as is offered in various malted extracts,--maltine, bromose, malted ~~xxxx~~ milk, and similar preparations.

M. M 1896-88.

TALKS TO JUNIOR MEDICAL CLASS, Dec. 9, 1901.

Physiological Therapeutics-- What is Disease?

J. H. Kellogg, M. D.

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To-day we will commence our course in Physiological Therapeutics. Physiological therapeutics comprises all remedial measures which assist the body in its efforts restore normal conditions of the body when in a state of disease.

Before we can understand what physiological therapeutics are, and their relations to disease conditions we must have a clear conception of what disease is, what disease conditions are and what we mean by disease. So I am going to ask you some questions now to see what are your ideas upon this subject; I will take up a general discussion of the question of what disease is.

Mr. will you give me your idea as to what disease is? ("It is a departure from that condition of the body which most perfectly fulfils its normal conditions.") You mean a departure in the body from those conditions in which its functions are imperfedtly performed-- is that your idea? (Yes.) Then you would say that disease is an abnormal condition of the body? (Yes.) That is true; but that is merely saying something about disease; but that is about like defining an animal as being an animal that walks about on four legs, that a dog is not a cat-- it is merely saying something about it but not explaining it-- it is not getting down to the root of things. We want a clear idea of the intrinsic nature of disease, the real fundamental character of disease. What is your idea of disease? ("It is a departure from the normal condition, either in the whole or a part of the body.") That is perfectly true,-- I see that you insist upon the same definition of disease; now let us see whether that really defines disease,-- what is the

normal temperature of the body? ("About 98.4".) Normally the interior or rectal temperature of the body is about 100°. Here is a person who has been walking fast or running to catch a train,-- by examination his temperature is found to be 102°-- is he sick? ("No.") Why does he have that temperature of 102°? It is because there has been an abnormal increase of heat production, is it not? (Yes.) Is not that a departure from the normal condition of the body,-- is he not sick to the extent of two degrees? ("After a number of boys have been running around two or three blocks their temperature is normal.") But they should have kept on running around the blocks for half, or three quarters of an hour in order to get a rise of temperature-- the experiment was not continued long enough. Suppose you go home from your studies here and go into the harvest field-- your temperature would be 101°-- is that a disease condition? That is a departure from the normal, but is it a disease conditon? ("No.") No; that is the reason I told you that definition was not a natural definition of a disease condition, but only a remark about it. Here is a person who has been exposed to cold and on a cold day, for several hours,- we take his temperature and it isfound to be 97°,-- is he sick? ("No Sir.") And yet it is a departure from the normal functions of the body. Then we do not mean to say that disease is a departure from the normal condition of the body while within physiological limits. The temperature is rising and falling all the while. The temperature after dinner is higher than it was before dinner,-- as a rule the temperature of the body is higher after a meal than it is before a meal, and it is higher in the evening than it is in the morning. So the temperature is continually fluctuating, but these are physiological fluctuations. So if we should say that disease is a departure from the normal state of the body, we mean that there are disturbances in the body which are beyond physiological limits,-- they are outside of those in which fluctuations of the temperature are contin-

ually occurring. The movements of the body are rhythmical, and subject to continual change, so we must go further in our definition, and allow an opportunity for those physiological changes, and we have a better definition,- such a definition as it would be to say of a dog that he is a four-legged animal and can bark, but it would not be a complete definition; we must know something more; that would not be a complete description of the dog. To have an exact definition it would have to be a complete description of the dog, and such a definition as would distinguish him from all other dogs, and we must make such a definition of disease, as to distinguish it from departures from the normal condition of the body within physiological limits. There is a difference between these departures from the normal conditions which are physiological, and those which are not physiological; for it is a departure in which the tissues are quickly restored to their normal conditions-- if the normal functions or condition of the tissues are quickly restored, then it is not a disease; but if the abnormal condition of the tissues become permanent, then the abnormal condition becomes a disease. Here is a man who takes food into his stomach - we will say he takes food into his mouth and as he chews the food, what is the first thing noticeable? ("An outflow of saliva.") There is an abundant outflow of saliva. This outflow continues so long as he continues to chew the food and the food remains in his mouth-- this outflow of saliva is normal; but if the outflow of saliva continues after the food has left the mouth hour by hour and day by day then a disease condition exists, it is insalivation. It is a disease because it is not a physiological condition, but a pathological condition,-- that is an illustration of the difference which exists between a physiological condition and a pathological condition. What happens when food is taken into the stomach? (An outflow of gastric juice.) There is no gas-

tric juice when the food first enters the stomach when the stomach is in a normal condition. Do you remember the experiments of Dr. Beaumont in looking through a window into the stomach of Alexis St. Martin after he had been taking food into his stomach-- how did his stomach look after the introduction of food into his stomach? There was a redness of the mucous membrane and an outflow of gastric juice which appeared like little beads of water. Here is a man who seens something in the nature of food, the flavor of which stimulates the outflow of the digestive fluids-- ("This is a mental stimulus. Yes; sometimes the sight and swell, sometimes the very thought of appetizing food stimulates this outflow-- makes the"mouth water"-- and the same thing that happens in the mouth happens in the stomach to some extent- and we are talking about the stomach. When food enters the stomach the mucous membrane becomes red and congested and the gastric fluid pours out abundantly,-- the blood vessels and the mucous membrane leak out gastric juice, so to speak.

After the digestion is continued for two or three hours there is not only redness but quite a congestion of the mucous membrane; but when the food passes out of the stomach into the intestines this condition rapidly disappears and the stomach returns to its normal condition in which it was pale and had but little blood. How long does this condition continue after dinner do you think? ("About two or three hours; it depends largely upon the nature of the food eaten and the time necessary for its digestion.") Yes, What is this digestion? ("It is gastric digestion.") Yes. The liver will remain enlarged until after it is time to unload its glycogen into the blood it continues to diminish in size until the supply is replenished. A starving animal, and elephant for instance, has a small liver. The livers of the rabbit and other animals are much larger after being fed on sugar-making foods. The liver becomes congested after a meal, and it must be restored to its normal condition state; if the meals are taken at proper intervals

then this restoration can take place and it is not a disease condition. But suppose a person takes a hearty meal, his liver in congested, and before the liver has had time to return to its normal condition, he takes another hearty meal and this adds to the congested liver, and he repeats that three, four, five or six times a day, putting pepper, mustard, peppersauce, and other unwholesome things which irritate the stomach and dilate the blood vessels until by and by a person would have a permanently congested liver, and after a time he would have a large, sensitive liver. An excessive amount of blood in the liver would have the same effect after a while, this would be a pathological or disease condition. Suppose a man has got too much blood in his nose. ("He has dilated capillaries.") Yes-- and if this continues, the capillaries will become permanently dilated-- and there will be something more - what is that? ("Hyperplesia.") Yes,-- his nose gets too big for his face-- would not the same thing happen to the liver from the same cause? (Yes.) He would have enlarged liver, or now suppose instead of returning to its normal condition, the stomach remains in this congested state,-- suppose the food that has been taken in consists of such things as mustard, pepper, peppersauce and other burning, stinging things, and includes rough, course foods,-- the result would be a continuation of this congested condition which would be a disease condition, while the other condition would be a normal one, hence not a disease condition, because the congested condition rapidly disappears. The same thing is true of the liver,-- the condition of the liver changes with every meal-- it differs in size after a meal-- it is larger after a meal than before a meal-- and why is it larger after dinner than it is before dinner? ("Because of the congestion; there is more blood in the liver after a meal.") Why is there more blood in the liver after a meal than before? ("There is an increase of the flow of blood to that part.") You think the absorption of food causes and increase of flow of blood-- would not

it be the other way-- that the increase of blood carries off the food into the liver. When the food is introduced into the stomach it acts upon the sympathetic nerves, and these nerves act reflexly through the solar plexus, the sympathetic ganglia stimulates the flow of blood through the large blood vessels, through the portal circulation, enlarging the arterial vessels so that they let more blood into the stomach; the increase in the amount of blood flowing into the stomach in response to the flowing in of food reddens the mucous membrane and floods the liver with blood, and then the liver stores up certain elements of food, as glycogen, etc.--- dyspepsia of the liver. This condition has been recognized as a pathological condition; it is a condition which exists among gluttons,not only among gluttons, but also among dyspeptics,-- because of the excessive and continuous congestion of the liver.

We might consider this for a moment: when the brain is active for a long time it becomes congested-- and is filled with blood and is red, rosy, and congested, and this is not a desirable state for the stomach to be in.

If a person has not enough sleep, he cannot sleep because of the activity of the brain, and if this condition continues, his brain would, after a while, become greatly congested,-- that would abe an abnormal state. The same thing would be true of the lungs, and the various nerve centers of the body. Supposing a person is using his arms continually,-- the centers that control the arm, would after a while become congested, and by and by there would be a permanent congestion. This would be a disease condition. By some particular occupation a person might get neurosis,-- such an occupation, for instace as bookkeeping, by which a person might get "writer's cramp".

Now the point which I wish to illustrate here, is this,-- that the difference between disease and ordinary physiological disturbances is not so great as might be supposed-- it is the same kind but not the same quanti-

ty,-- it is the same thing in disease only the abnormal deviation is exaggerated-- in many cases this is only an exaggeration of normal deviation,-- for instnace a chronically congested condition of the stomach is simply a state in which the mucous membrane of the stomach is continuously congested, it being normally congested at every meal; but when the physiological stimulus of the food and the physiological congestion become abnormal, then it is a disease condition. The continuous activity of the stomach renders it a very difficult matter to cure a chronic inflammation of the stomach. We must use the stomach continually, although it needs rest, hence it is difficult to cure it when diseased. On the other hand, if you have an inflamed knee joint, or elbow, you can place the part in perfect rest, and nature in the meantime heals the part while it is resting. But you cannot put the stomach to rest except at limited periods. Rest is the great remedy-- unfortunately, we cannot spare the stomach long enough for the proper amount of rest, for this measure can only be employed in a limited way. If the eye is inflamed, we can bandage it and let it rest until cured. But if a person gets a diseased condition of the tongue, for instance, if it is swollen or inflamed, it must rest for a time,-- but it is very difficult to let the tongue rest for a long time (laughter) ,-- it is hard work to keep the tongue still, but a wounded limb can be laid aside and permitted to rest until cured.

But the lungs, liver, kidneys, bladder, stomach, spleen, etc.,-- when they become diseased, the physiological activity of these organs constantly interferes with the healing process. That is the reason it becomes so difficult to deal with inflammation and congestion of the viscera, although external injuries are readily dealt with. But we must give these organs rest, as far as possible.

Now let us see if we can get a clearer idea of what disease is. Now what would you say of disease? ("It is an exaggeration of the normal

activities of some of the different organs") you would say it is an exaggeration of normal deviations. ("Brought about by unnatural conditions.) It is difficult to make a diffinition of disease which includes everything. Here is one thing that stands in the way: our colloquial and ordinary use of the term "disease" is not a scientific use of the term. When we talk about disease in common parlance, we sometimes mean merely a symptom of disease; sometimes by "disease" we simply mean the cause of disease; and sometimes we mean simply the phenomena of disease-- all the phenomena of disease put together. But that is a very lo se way to speak of it. When we talk about disease technically, we must confine our thoughts to one thing, but it is difficult to separate things. The ordinary definition of disease is loose because, as I said, it is applied to many things-- for instance, we say a person has a cancer-- what do you mean by that, what are we talking about then? We are talking about abnormal development of the tissues,-- you have an ugly mass or tumor-- a new development of tissues. properly speaking, that is not a disease condition in the sense in which we are talking about it. Cancer is a product of disease-- it is a result of disease, and not a real disease. Now what is a disease? When a person has a cancer (diagram) suppose a person gets a cander,-- what is that? we look at it and say it is a "cancer", but is cancer a disease? You say a person has an ingrowing toe-nail,-- is an ingrowing toe-nail a disease? ("It is a cause of disease?") You might say a tight shoe is one cause of disease,-- that is the first cause; then the turning in of the toe-nail is another cause; then the pressure of the toe-nail upon the tissues causing swelling, pain, redness, suppuration, in fection, andinduration and a number of other things happen which constitute real disease; so the ingrowing of the toe-nail is not a disease.

Now take this cancer-- what is it? It is an obstruction of nor-

mal tissue formation. But when we get down to the root of the matter and look closely into it we find that there is an active process by which cancer is being produced and combated by the leucocytes and cells of the body. We might say it is a result of the reception within the body of animal parasites and the infextion of the body by these parasites, which produces cancer. I cannot prove that this is true, but I think it is going to be proven to be true, I have for many years thought that this is the cause of cancer although I cannot prove it. But suppose this infection gains ground,-- the leucocytes and tissues are destroyed and an abnormal development of tissues occurs in the infented part, under the influence of toxic nubstances formed by these parasites, and under the stimulating influence of the excessive amount of blood, hence there is such a stimulation as to produce an abnormal growth and development of tissue in which there is very little vitality. The tissuesare so intoxicated by the poisons formed by these parasites that they die, and then a sloughing and ulceration occurs, and masses are broken off, and we have left a suppurating gangrenous mass. Now in all this, what is the disease-- is the cancer a disease? ("No.") What is a cancer. ("You say it is a result of the action of parasites.") It is difficult to get a precise definition.

Now let us look at some features of cancer: There is an excessive growth of tissue which is a characteristic feature of the disease. Now are the tissues of cancer new tissues formed within the body? (No.) What is a peculiar thing about cancer? It is the manner in which the tissue elements are arranged and developed,-- there is an abnormal development of tissues. In a healthy condition there is an normal development of tissues by exercise - for instance, here is a boy, and a young person , one of you for instance-- go home from your studies and from your laboratory researches,--

handling test tubes, etc., and you go to work chopping wood, hoeing corn, or working in the harvest field, handlin the shovel or holding the plow,-- there is a stimulation and a consequent irritation of the tissues by exercise by which your hands are blistered. Theblister heals and by and by the skin of your hands becomes hardened and thickened and you find that there has been a growth of tissue. So there is such a thing as normal stimulation of the body by which tissues will assume a greater growth-- exercise may stimulate the growth of tissues, but is that true of muscle fibers? ("No".) Then what is the use of exercise? ("There is an increase in the size of muscle fibers but not an increase of the number.") I am glad you know that. There is no formation of new muscle tissue-- no addition of muscle tissue by exercise, but there is an increase in size. Now the same thing happens here the muscle tissues are being continually taken down and rebuilded, and the same thing happens to all different tissues of the body,-- they increase in size. The muscles increase in size, increase in size of the individual cells. The heart is also increased in size by the increase in size of its individual cells, and we have the same thing in the skin. If we examine the skin and count up the number of perspiratory glands, before prolonged hard work, and then examine theskin and count up the perspiratory glands after prolonged labor or exercise with out hands, would there be any increase in the number of those glands? ("No.") We might find a slight increase in the number of blood vessels-- some of which are constantly being formed anew. We might find small new nerve filaments which are jutting out to protect the newly formed tissues, but we have no new dermic fibers formed. Now it is an abnormal increase in size of the tissues that occurs in cancer. so when we look at cancer we conclude that it is an abnormal increase or proliferation of the tissues though the abnormal stimulation of the vital ac-

tivities caused by the cancer parasite,-- this disease is an abnormal vital action taking place through the action of these disease producing elements, the cancer parasite, causing proliferation or increase in size of the tissues-- when we find this condition we call it "cancer". But we will discuss this subject a little further to-morrow.

What is the cause of disease? This a is a very important question for us to understand very thoroughly so as to know whether we are really rooted and grounded in the true medical faith. It is a wrong conception of disease which renders people subject to deception by quacks, charatans, patent medicines fdealers; and I find people who have been better taught, when they get into an emergency they through away their faith in their principles and fall into the "customs of the age", which Paul said we must not follow.

So I hope you will get where you cannot be shaken. There is a right and wrong and truth and error in reference to every proposition, and we want to know truth and the reasons for truth, and know them so thoroughly that we cannot possibly be upset. So I wish you would think of this question further; we will discuss it further and I hope before we get through we shall have a clearer conception of what disease is.

TALKS TO JUNIOR MEDICAL STUDENTS. Dec. 10, 1901.

Physiological Therapeutics. (con.)

J. H. Kellogg, M. D.

We must get a clear conception of disease, and what disease means, and what it is, and when we get a little further on, you will see the reason for this close attention to the nature of disease. I am anxious that you should have a correct idea of the sound philosophy of this matter. I do not think it is worth while for us to go over the things that you have learned in books, because you can get them out of books as well as I can; but I want to discuss things that you cannot find in books and help you put together materials in a philosophical way and to build up correct theories and find out correct principles, so that you can be based upon a firm and enduring foundation. A short time since, a lady asked me a certain question pertaining to therapeutics, and I answered the question in accordance with the principles of rational medicine. "My doctor", she said, "you have a most remarkable memory". I said I did not think I had a very extraordinary memory. "But", said she, "you must have a remarkable memory, for I asked you that same question some fifteen years ago and you answered it just as you have answered it now,-- how could you remember it so easily and so long? I confessed that I had forgotten that she had asked me the question, but I said, "It is the same question, is it not?" "Yes", she answered. "Then why should I not answer it now just as I did in the first place? What was true then is true to-day." I answered her in accordance with true therapeutic principles, and if I had answered without reference to these principles I should have answered differently. But I answered according to a principle that was true then, and just as true now as it was then, and so the answer must be the same in order to be correct. The principle is the touch-stone -

so that when you get a principle you can answer questions to which that principle is applicable and always answer that correctly. A principle is a sort of counting machine. A certain man has made an experiment that will solve an equation with three unknown equations; all you have got to do is to turn a crank, and the equation is solved. There is also a machine been invented that will solve an equation with six quantities in the same manner. So it is with principles. If you are going out to treat some one or to operate upon some one, and you think "If I could see such a doctor treat such a case, I would know how to do it, " you will get into trouble, because you never find identical conditions in different patients. But if you understand the principles of medicine you will be able to formulate prescriptions applicable to special cases.

First then, we must study to know what disease is, and in order to do that, we must know what health is. Suppose we try to define health,-- we might say, "Health is a condition in which such a degree of fital equilibrium is maintained as will secure the highest degree of comfort, wellbeing, vigor and duration of life? "That is my definition of health,-- and perhaps you can improve it. I wish you would criticise it and discuss it and see if you can improve it. And when there is such a disturbance of the vital equilibrium as to seriously interfere with the comfort, wellbeing, efficient activity or long life, the individual is in a state of disease. I think that is the best I can do in formulating a definition of health and disease, giving general definitions of each.

Now the nature of the process of disease, and the nature of the process of health are precisely identical. The thing that I hope to demonstrate is, that the difference between disease and health is not essential,-- there is no essential difference between the vital process of health, in their intrinsic character, and the process of disease; it is a difference in quan-

tity or quality ratherthan a difference in intrinsic character, and it is a difference in quantity rather than in quality, but the real process is the same in disease and health. This is a very vital fundamental principle.

The ancients believed that disease was an entity; that when a man had a disease, he had a demon or devil in him which must be gotten out; they thought the sick man acted as though he was possessed, and so he was thought to have some sort of demon in him and that this demon must be gotten rid of. And the modern idea of disease is but little different from that of the ancients. The only difference is, that the idea of an intelligent demon in the sick man has been gradually eliminated, but that, instead, there is something in the sick man that must be cast out. The truth is, that the cause of disease must be eliminated; the disease itself is not a thing to be destroyed, nor to be combated, nor a thing to be eliminated; it is not the disease that you want to cure, and you never want to try to cure disease,-- you want to cure the man and not the disease; you want to cure the cause of disease and stop the results of disease, but you must remember that disease is not a thing to be cured. It is easy to cure disease by covering up the consequences of disease,-- for instance, if a man has a severe pain, we give him opium to relieve the pain. It is the cause of pain that needs to be removed and then the pain will not only be relieved but the patient cured.

It is generally supposed that disease is an evil; that it must be arrested, discouraged, and destroyed; but this is not correct. Disease is a thing to be assisted and helped. When we get down to the root of the matter we find that disease is really nature at work under abnormal conditions- it is the carrying forward of the vital processes under abnormal conditions, and these vital processes are not to be destroyed or discouraged, for this is a curative power within the body that is working for the restoration of

the body to health by removal of morbid conditions and the restoration of the vital equilibrium,-- this power is to be assisted, encouraged, and helped, so that the morbid processes can be brought to an end, not by discouragement of these efforts of nature, but by actually assisting in the work which she is trying to do.

In order that we may understand the situation clearly, let us study for a little time the thing that nature does to maintain the vital equilibrium. Disease is a disturbance of the vital equilibrium and such a disturbance as interferes with the comfort and wellbeing, and which produces pain and other disturbances.

Now let us consider some of the things that nature does to maintain this equilibrium,-- in other words, let us study the defences of the body. Those defences are not defences against disease or entities but are the processes by means of which health is maintained; and these processes by which health is maintained are the processes by which health can be restored,-- and they are the only processes by means of which health can be restored. This is a generalization of the greatest importance, because it puts us on the right track in rational therapeutics.

If we accept these principles we shall see clearly that disease is a beneficial departure from abnormal processes ; that it is the effort of nature to restore normal conditions; that it is beneficient instead of malign in its character; that it is intended to restore normal conditions in the body; that it is simply an exaggeration of vital activity-- an exaggerated effort on the part of the body to restore normal conditions, and an effort to correct a failure on the part of certain functions of the body which exists because of overwhelming bad conditions. But in disease, all the powers of nature-- all the powers of the body are struggling all the time to maintain health to that to say that disease exists is simply to say that nature

is endeavoring to maintain health under adverse conditions. Then we say that in the cure of the patient all we can do is to aid nature in her efforts to establish right conditions by controlling or removing abnormal conditions, restoring normal conditions, and aiding in making conditions normal within the body.

Now let us observe what are some of the defences of the body. If we understand the nature of these defences we will know how to aid the body by the employment of natural means. We will find when we come to talk about physiological therapeutics, remedies, so-called therapeutic agencies,-- electricity, water, light, etc,-- we will find that all these agencies are in operation in the maintenance of health,-- we shall preceive that all our hydriatic principles are involved and are continually at work every moment of our lives. So in the use of phototherapy, electrotherapy, and all other physiological agencies which we employ, we introduce nothing into the system in dealing with the sick man; we are only emphasizing the principles and utilizing the agencies which are continually in operation and which are essential for the maintenance of halth.

This morning let us consider some of the natural defences of the body, and in doing so let us start with one of the most simple things,-- and yet one of the most remarkable and potent of all the means by which the body defends itself against what we are pleased to call "disease", and which would be more properly called causes of disease-- viz., the alkalinity of the blood. We know that the blood is alkaline, and also that nearly all the fluids of the body are alkaline-- with the exception of what? ("The gastric juice"). Is that the only exception? ("urine.") There are two exceptions-- hydrochloric acid and the urine-- what is the acid of the gastric juice? ("Hydrochloric".) It is really an organo-mineral acid. It has been shown by actual observation that it has at least twice the efficiency

of mineral acid, although it has some of the elements of the mineral acid in it, and the hydrochloric acid of the laboratory is a substitute for it,-- what is the acid of urine? ("It is a sodium acid phosphate.") Is that the only one? (Different answers.) Uric acid is found there, and the acid phosphates are found there,-- it is in solution-- and these are organic acids-- at least they were such originally. The probability is that when we get at the root of the matter, we will find that, as these exist in the body there is a more complex molecule of which the sodium acid phosphate is a part, and that it does not really exist there in its normal form after all. With these two exceptions all the fluids of the body are alkaline; there must be some reason for that.

It has been noticed by many observers that the diminution of the alkalinity of the blood is coincident with various disease conditions,-- for example, Schiff has shown that in fever alkalinity is diminished, and in a number of diseases the serum of the blood is almost neutral.

In diabetis the acidity of the blood may become so great that the breath will have an acid odor-- what is that acid? ("di-acetic".) Yes-- its compound-- I will state the question again: what is the acid that that gives the breath of the diabetic patient its peculiar acid odor? (Answer not understood.) you may look that up and report it tomorrow. Now that acid is found in diabetics-- how about rheumatism? There is a diminished alkalinity of the blood in rheumatism,-- and what else? There is an increase in the acidity of the urine, also of acidity in the perspiration. Perspiration is ordinarily neutral, but in rheumatism it becomes acid. It is not because the blood becomes acid-- the blood does not actually become acid,-- but the increase of acidity is the result of diminished alkalinity of the blood, although there is one case reported of a person who died of cholera, and the serum of the blood actually became acid just before death. There are other

maladies in which the alkalinity of the blood is diminished, as in the uric acid diathesis, in which the urine becomes more acid,-- what is the acidity of the urine? (" 1000c.c. daily.") We must taken into account the the quantity of urine. I think, in estimating this acidity properly, we ought to increase the quantity of the urine in reference to the height and weight of the individual. For example, for a person who ought to pass a thousand c.c. of urine the acidity might be two, but that would be the same as one with a normal quantity, so we must take that into consideration.

It has been noticed also by Sherwin (?) , Bouchard, and others, that the acids greatly decrease the vital resistance.

Now let us consider what are the sources of this alkalinity that results in the decrease of fital resistance. Name some of these sources,-- what sort of acids abound in food? ("Fatty acids-- lactic acid, etc.") Where do you find lactic acid? ("In tomatoes."(Where do you find it in abundance? (In pie plant.) Name another acid. ("Tartaric acid.") Where do you find that? ("In grapes.") Name another. ("Citric acid.") Where do you find that? ("In lemons.") Do you know any other fruit that has citric acid in it? ("Oranges.") What other fruit? Limes, cherries, and cranberries. Name andther acid. (Malic acid.) Where do you find that? (In apples.) Of all people, we ought to be wise in reference to food-- we ought to know everything about food; we ought not to be content withanything less than to know every thing that is to be known about food; people have a right to expect this of us. We are specialists in food, and we must not forget this. What other fruits have malic acid? Malic acid is a fruit acid, and this is generally found in nearly all fruits. Some fruits have a mixture of acids, but malic acid is found in nearly all fruits. Now mention another acid which is found in fruit. ("Acetic acid.") Under what condtions would you find that? ("In fermentation.") Yes; you will find it in pickles,

vinegar, but it ought not to be found in foods. What kind of acid do you get in eating buttermilk, or kumyss? ("Lactic acid.") What other acids can you think of? (" Butyric acid.") where do you get that? (In butter.) Yes you find it in strong or rancid butter. What other acids can you name? ("Tanic acid.") Where do you get that? (In tea.) Where else do you find it? ("In blackberries and raspberries, etc.") You find tanic acid in nearly all astringent fruits. Where else do you find tanic acid? ("In unripe fruits.") Any other? ("Hydrochloric acid.") You get that in medicine but I don't think you get it in fruits. Where else do you find it? ("There is some in peach pits.") But they are not food,-- you don't often eat them,-- but you get it in bitter almonds. We also get some formic acid in honey. You get a variety of acids in cheese, as butyric acid, lactic acid-- cheese is very acid. Do these acids diminish the alkalinity of the blood? ("No,-- they increase it.") Yes and no,- when the acids are absorbed they increase the alkalinity of the blood temporarily because they are acid and combine with alkali, but shortly oxidation takes place, and then there is a conversion of acid into all these organic acids-- and what are they all converted into? (" C_2 ,, O_4, H_2")..... Now when the oxalic acid neutralizes the alkalinity what will be its effect upon the blood? ("It diminishes its alkalinity." And when oxidation has taken place, this acid has been converted into carbonic acid gas, and this has been thrown into the air and there is nothing left but water,-- and what is the effect? Nothing at all. So that while the temporary effect would be to diminish the alkalinity of the blood, the ultimate effect would be to increase it-- for how long a time would the alkalinity of the blood be diminished? Until the process of oxidation takes place Suppose you had a patient whose oxidation was slow, and the oxidation processes were not proceeding at their normal rate -- what would be the effect? To diminish the alkalinity temporarily-- what do our experiments in

laboratory show? ("That the alkalinity would be diminished.") Yes, it would be so at first, and the acidity of the urine would be increased; this would be true of all the acids. So we must take these things into consideration. What other acids can you think of? ("The acid formed in the cells of the stomach.") Yes,-- and these acids may decidedly diminish the alkalinity of the blood because the acid is absorbed in the blood. You will find that is hyperpepsia there is a constant relation between these two things, but we must remember that the acids taken out of the blood go back into the blood and thus the alkalinity may be diminished. Give us another source of acid in the body, and one which is much more important than any we have yet mentioned. ("Uric acid from proteids.") Yes-- in foods-- but there is something more important still. ("Acids produced by fermentation in the stomach.") Yes, acids formed in the stomach itself by fermentation--name some of the acids formed in that way. ("Lactic acid.") What is lactic acid formed from in the stomach? ("From fermentation in foods.") (To another student) What would you say? ("It may be acid formed from milk.) From what part of the milk? ("The lactose.") Yes-- it may be formed from starch or albumen-- can you think of any other acid? ("Butyric acid, formed in fat) What other acids? ("Carbonic acid") That is of no account, because it passed off. What is an important acid in certain causes of disease? ("Acetic acid.") When a person has a sour stomach there is generally lactic acid present; this occurs only when a person has been eating bread baked with plenty of yeast - he might have acetic acid formed from the action of yeast. Under what pathological conditions do we have acetic acid-- which we have from the presence in the stomach of too large a quantity of yeast? ("A dilated stomach.") Yes. And in cancer, it is found to be true in some cases. Now can you think of any other source of acid? ("The action of the muscles.

I am glad you thought of that-- the formation of lactic acid in the muscles by muscular exercise-- now another? ("The same is true of the nerves.") That is not a very important source of acid. The waste products of the body are, for the most part, acid, but they are imperfectly oxidized;- these substances are acid in their first stage of oxidation but when they are completely oxidized the acidity disappears. So you see what an important part the acids play in the processes of the body.

There is still another acid formation which has not been mentioned-- what is that? ("Acids formed by germs in the alimentary canal.") Germs may form a number of substances containing acids which may diminish the alkalinity of the blood. Germs acting upon the albuminous substances in the bronchi may produce acids. Now we will pass on to see what all these really signify.

The most important acids that we have to consider are those acids that are formed in the tissues, and which are not rendered alkaline by complete oxidation. These acids result from incomplete oxidation. Now take an example, for the sake of impressing this on your minds: here is a man who is doing hard work-- how much work does he do in a day? (Making calculation on the blackboard.) He does 250,000 kilogram-meters, or 1,800,000 foot-pounds, - that is a day's work-- you ought to remember that. This matter of work has a very important relation to food. Now how much of the food that is taken into this man's body is expended in work, and how much in heat production? ("About 1/4 in work and 3/4 in heat production.") That is correct, and this is in accordance with the latest researches,-- and it shows us that the body is the most perfect machine that has ever been constructed. The ordinary steam engine or locomotive utilizes only about 1/6 in work, while 5/6 is wasted in heat. Now suppose this man is an ordinary sedentary man,-- a student,-- one of you for instance-- you are doing but little muscu-

ler work-- how much work will you do? From some estimates that I made some time ago, I made up my mind that the amount of work done would be no more than 1/6, so I put this as the maximum amount of work done in the Gymnasium, but I think it is too small. (Making calculation.) How many ounces would that be. ("About two ounces of fat.") Yes-- in neglecting to do his day's work this man has left two ounces of fat completely unoxidized. So if a man does not work, he must lessen his diet, there is absolutely no escape from that conclusion. This man is punished for this neglect to work-- his body is filled with imperfectly oxidized substances, and he cannot oxidize them except by work. So it is absolutely necessary towork in order to prevent the formation of acids, the result of imperfect oxidation. The man who does not work and who eats much food is certainly "putting a knife to his throat", as the wise man says-- he is committing suicide in this way. When a candle burns out, it is mostly converted into CO_2, but when it is blown out, there is a little spark left, and the smoke contains poison which makes the throat smart and makes one cough; when there is a few cubic inches of that smoke in a room it will start one to coughing; you have noticed that in blowing out a candle. The same thing is true of the human body,-- when there is a deficiency of muscular activity the body is filled with poisons which diminish the alkalinity of the blood and the whole body is deteriorated. We have other evidences of this: when a person uses a considerable amount of sugar it seems to have the same effect, because the sugar must be oxidized; when you have more sugar present than can be oxidized, then the oxidizing processes of the body are diminished in the perfection of their operation. That is the reason you find that those who eat much milk are very subject to boils, because there is so large an amount of sugar in the blood and the incomplete oxidation which is the result of the presence of so large an amount of sugar. This also leads to a lowering of the vital resistance, and

then germs invade the body. This is true in diabetic - persons suffering from diabetis are very subject to boils. But skin diseases, gangrene, and various other disorders of the body, arise from the infection of the body with germs; persons suffering from rheumatism and gout are continually subject to skin diseases, and their bodies are readily infected with germs of various sorts. How do you know this is true? Experiments have been made, which have shown it to be true. By the injection of lactic acid into the tissues of animals, it has been found that they become subject to the action of germs and this was observed in cases in which germs would not grow in the tissues before injection was made; it was found that the microbe culture of this kind weaken the tissues and lessen the vital resistance, and germs become active in the body.

Sherwin and Rogers have shown that when animals become much fatigued they become subject to disease in precisely the same way, because the body becomes filled with poisons to such a degree as to diminish the alkalinity of the blood. When a person exercises vigorously what is produced? ("Lactic acid.") ..... The serum of the blood has power to destroy germs as has been shown by------- Germs destroy the cells,-- how is this done? ("By the toxins which the germs produce.") And they first intoxicate the cells which are the sentinels of the body-- they put the sentinels of the body to sleep when they come in contact with the poisons-- the sentinel gets drunk on their poisons and they kill him and walk in right over his dead body.

There is another way in which vital resistance is lowered-- and thi is a very important point: there are vaious diastases, or ferments, in the body which are for an important purpose-- for example in the saliva-- what is that? ("Ptyalin.") All these ferments, with the exception of pepsin,

require what sort of element? ("An alkaline element.") Yes. The blood contains ferments, the highest degree of actigity of which is necessary for the maintenance of life. There is a ferment which promotes the coagulation of the blood, and there is also a ferment which hinders the coagulation of blood entirely
The whole series of ferments which have not been oxidized, are known by the name of oxydases. The energy of the muscle is set free by the impulse from the brain which touches off, so to speak, the the nitroglycerineof the muscle, by the combination of the oxygen with the glycogen in the muscle. There are six classes of ferments,-- the sugar forming, the maltose transforming, the food transforming, the coagulation promoting, the coagulation hindering, the fat making ferment and also the oxydases. These act with great facility in an alkaline medium, the alkalinity is diminished in the acid medium.

When the muscle has been acting for some time, it is tired, and the weariness and the fatigue of the muscle are due to the fact that the acid lessens the power of the ferment,-- the action of the ferment is prevented by the presence of the acid. These things have been worked out by Bouchard and other investigators, and this is one step further which has been made in knowledge concerning the mystery of the chemistry of the body; here we take one step further in the unknown region, and this has been a great help. We have no learned something about how the alkalinity of the blood defends the body and how the diminished alkalinity of the blood results in disease. An increase in the alkalinity of the blood causes the bones to become soft, so the bones of a growing boy are soft, and we have a disturbed metabolism,-- perhaps the boy is growing too fast,- as a result of diminished alkalinity of the blood and the interference with the action of the oxydases which control nutrition, and metabolism, and tissue formation and result in malnutrition-- overgrowthin some places and diminished growth in others, by means of which the equilibrium of the body is disturbed. So you see how important it

is that the alkalinity of the blood should be maintained, and that anything by which acids are formed in the body to an abnormal degree lessenes the vital resistance and interfers with the successful treatment of what we call disease."

TALKS TO JUNIOR MEDICAL STUDENTS. Dec. 11, 1901.

J. H. Kellogg, M. D.

Physiological Therapeutics (con.)

I hope you are getting some of these fundamental principles impressed upon your minds because they are of the utmost importance in practicing medicine in an intelligent way. It is one thing to grope along, blindly trying different things, and this has been the usual method of practicing medicine, but it is another to practice medicine intelligently. The usual method of practicing medicine is a most ridiculous farce, and simply relies upon the vitality of the patient. For example, there is a new drug been discovered in South America which is claimed to be a sure cure for scrofula, but what relation exists between that drug and scrofula nobody knows; it is a drug used by the Indians of South America for scrofula, and hence it is supposed to be a certain cure for scrofula by the civilized world. But this does not work, so next year another drug is discovered in the same manner. In this way new drugs and poisons are brought before the public and sent out and sold in large quantities by pharmaceutists and drugists. So, if there is a weed that has a reputation for killing cats and dogs and a good wolf poison, or used by Indians to poison arrow heads, it is a "good medicine"; it is a good medicine, because a thing that will kill cats and dogs and other animals must be capable of curing people,-- and the drug that wont kill is - not worth anything; so the doctors use such things "to play upon the vitality of the patient." The drugs usually depended upon in the practice of medicine are the most powerful poisons,-- mercury, strychnia, etc.

Now physiological therapeutics is the direct antipodes of all this. Physilogical therapeutics undertakes to cure disease by the same means by which we preserve health, only these means are applied in a way that is a-

dapted to the individual's condition,-- for instance, if a man is hungry, you give him more food than you would if he has just had a hearty meal. If a man's vital processes are too active we take measures to slow them down, and if they are sluggish we will employ the means which nature uses to hasten them.

We are talking about the means by which the body defends itself. We have talked about alkalinity of the blood, and have observed how the alkalinity of the blood defends the body by increasing vital resistance, and how diminished alkalinity of the blodd decreases vital resistance and renders the body more susceptible to the influence of germs-- it lessens the vital resistance of the individual cells, rendering the person more open to infection. We find the relation that exists between the diminished alkalinity of the bloodand differentdiseases. It has been noted that, in most chronic diseases alkaline is decreased; in rheumatism, Bright's disease, diabetis, gout, pneumonia, chlorosis, and obesity-- why is the alkalinity of the blood diminished in obesity? ("Deficient oxidation.") A person is taking is such a large amount of hydrocarbons or carbohydrates that he cannot oxidize his fat, and so some of it is laid aside. Now can that be the case where oxidation is complete? ("No.") He has laid it aside because he has taken in more than can be oxidized. This is evidence that oxidation is not complete So while there is an accumulation of fat in the body, there will be what? ("Decreased alkalinity of the blood.") To what is that due? ("It is due to acids which are unoxidized.") Yes; wherever there is an increase of fats in the body there must be an abnormal accumulation of imperfectly oxidized wastes. I want you to see that.

It follows, then, that the over-fat man is a sick man, so that the lean man is, in that respect, better off than the fat man, because the

lean man may be in perfect health, while the over-fat man is not. How would it be with the over fat ox? ("He is sick?") The how is it in reference to the germs of disease in the flesh of such animals? Is it rich in anything? ("Yes-- in waste matters.") Then the more juicy, highly flavored, tender, and toothsome the flesh of such meat is-- then what? ("The more poisons there are present.") Then it follows that the flesh of the working ox is what? ("Dry and tough.") Yes; in order that the meat shall be juicy, tender, and toothsome, the ox must be shut up in a stall, and stuffed with food until there is a large amount of accumulated fat, and also a large amount of soluble but imperfectly oxidized wastes or extractives known as "beef juice" but which are simply urine and sweat which has not been sorted out; if that were sorted out, the acid elements would go through the kidneys, and the alkaline elements would go out through the liver,-- as a rule, the kidneys remove the acid wastes and the liver removes the alkaline wastes. When these wastes are mixed together they form "beef juice" and are soluble. Living tissue is not soluble,-- if it were, it would be dangerous for a man to fall into the river, because he would dissolve; and if a dog went into the water for a swim, he would dissolve-- but he does not dissolve. But when an animal dies he becomes soluble. Organized living matter is insoluble but when it breaks down and dies it is soluble, and the more oxygen there is combined with it, the more complete the oxidation, and the more complete the solubility.

These are all interesting matters for us to have in our minds, because they are fundamental; bwe must keep them in mind in studying conditions and in dealing with people; we must remember that this thing is true,-- that the fat man is a sick man,-- and the same thing is true of the fat ox-- he is a sick ox; the fat hog is a sick hog, and so of other animals, and the condition brought about by the fattening process is a state of disease-- this is

certainly true.

There is another thing that produces fat and in which there is diminished alkalinity-- what is that? ("Excess of acid in the body.") There is another state in which this exists, in growing boys-- there is a diminished alkalinity of the blood in the stage of growth which renders a boy or girl more susceptible to disease-- what sort of disease is that? ("Infectious diseasse.") Typhoid fever, tuberculous disease, etc-- that is because of diminished resistance of the body during that period; probably that may be due to the presence of a large amount of alkaline material in building the bones; while building the bones is going on, an active metabolism is taking place in boys and girls, resulting in diminished alkalinity. So we should not diminish the alkalinity by diet. What things would you think would be particularly dangerous for a growing boy-- anything that will diminish the alkalinity of the blood by diet. (" Eating a large amount of acid fruits.") That would be temporary-- it would not be permanent-- it may be that acid fruit might diminish the alkalinity of the blood when such foods are eaten but is only a few hours before oxidation takes place; so that if a boy filld his stomach with cherries/apples he may be rather uncomfortable, but the penalty for doing that would be, to give him something that will diminish the acid formation-- such as hoeing corn or digging potatoes-- something that will introduce a large amount of oxygen into his body. There is another way in which the growing boy may be damaged besides taking in a large amount of acid fruits, and that is the use of meats, and this is so because meats contain uric acid and they will diminish the alkalinity of the blood. Active, carniverous animals who live out of doors and run about a good deal, can eat meat with impunity because the uric acid is converted by the oxygen of the air into urea by which removal is facilitated; that is the reason carniverous animals can tolerate a meat diet. But when we put a sedentary animal, man,

for instance, upon a meat diet, we have all these difficulties intensified-- we have lack of oxygen hence the uric acid taken in with the food and other surplus materials are certain to go unoxidized and then there must be an accumulation of waste materials within the body. We see that the predatory races, the Patagonians, for example, who live mostly on horse-back and lead an active life, can live on an exclusive meat diet and they are hardy and vigorous, but they are not long-lived. They are vigorous because their active life burns up the uric acid. But this is not the case with a sedentary man.

There is another thing which diminishes the alkalinity of the blood, which it is important for us to notice, and that is the use of an excessive amount of sugar; sugar is not injurious providing we do not carry its use to an extreme. A child needs sugar and this is one of the most important means of promoting growth. But an excess of this element produces rickets, and the same is true of an excess of proteids and of any harmful article, because it produces a diminished alkalinity of the blood and deficient oxidation. Rickets in a child is due to diminished alkalinity-- this is the real cause of rickets. A diminished alkalinity of the blood causes a too strongly acid tendency in the tissues to produce a disease in which there is an absorption of the increase of the deposit of alkaline matters in the bones, just as diminished alkalinity produces a disease in which there is absorption of bony material. Here we have the same thing-- diminished alkalinity of the blood may lead to disease of the bones in adults, and is one direct cause of softening of the bones of children in rickets; Anything that diminishes the alkalinity of the blood will do that; a meat diet will diminish the alkalinity of the blood and so meat diet may be the cause of tickets. Do you know of anything else that is a common cause of rickets? ("Cow's milk.") Yes; anything that will produce a sour stomach or fermentation in the alimentary canal, in children, produces a diminished

alkalinity of the blood, and so it may produce a softening of the bones or rickets. If a child eats cane sugar in such large quantities as to interfere with digestion, or flood the body with saccharine material, more than can be perfectly oxidized, in either case we have diminished alkalinity of the blood, whether from fermentation of the stomach or absorption of acids through the entrance of this material into the blood; the oxygen is used up so that there is not sufficient oxidation, and then there is a consequent accumulation of wastes in the body; in either case we have diminished alkalintiy, and we also have an excessive residuum of acid wastes; thus we might have a diminished alkalinity, and thus have a disease condition of the bones. You see how practical it is to take up these physiological facts and fo into the depths of the subject, going far enough to see what it signifies.

Now let us take up another question-- the defence of the body afforded by the glands-- what are the internal glands? They are the glands which produce internal secretions; we will call them the ductless glands; what is one of these glands? ("The thyroid gland.") Do you remember another ("The supra-renal capsules.") Can you name another? ("The thymus glands.") There is still another class of glands-- the sexual glands must be mentioned with the rest as producing internal secretions; they are not ductless glands, but they produce secretions which may be absorbed in the body; then there is the spleen. It has been found that the removal of the thyroid gland results in the production of structural changes of a serious character, causing general deterioration of the organism, and often death; a cachectic condition is produced-- what is this condition called? ("Cretinism".) When this gland is removed the result is cachexiaor strumipriva. In some dark valleys of the Alps where the cliffs rise half a mile high, and the sun does not appear in the valleys until about 11 o'clock in the forenoon and dis-

appears about three in the afternoon, it is found that the thyroid glands in some cases are enormously enlarged and they have large goitres. In traveling in the Alps some eighteen years ago, I found that men had bands around their necks holding up big goitres; I saw one man with a band around his neck holding up an enormous goitre. These people feel proud of their goitres, and it is rather fashionable to wear them, and I understand that there is sometimes a sort of competition to see which will have the biggest. Children also have them. In the cases of those who have these enlarged glands there is metal depression and weakness of the mind, and all the forms of cretinism; all these are found to be due to want of sunshine. This is found to be the case of children who live in the highest altitudes of the Rockies. For this reason the government of Switzerland has been erecting hospitals in higher altitudes where the sun shines during the greater part of the day and with this aid and with proper care and treament in these hospitals there are many cures,-- but this is in cases of cretinism. But we have a much more serious disturbance which occurs when the thyroid gland is removed,-- there is a sort of atony of some sort which is called "Myxoedema." This rather a rare disease; we have a case or two of this kind at the Sanitarium almost all the while-- I think we have a lady there now who is suffering from that disease.

In this disease there are peculiar characteristics,-- the person begins to show a little dullness of intellect, a slowness in making up his mind; he seems to be perfectly rational but a little stupid. After a time his speech is slow and the tongue thick and the hands become clumsy, and the feet become clumsy and slow, and the whole activities of the individual seem to be slowed down in their processes; then there is a peculiar complexion-- a pale, sallow color, as in Bright's disease, and there is an appearance of

being dropsical, the face has an expressionless appearance, and the skin becomes dry and harsh, the limbs and hands are swollen, and the whole individual seems to be in a state of degeneration. The there is also another feature of this trouble, and that is that there seems to be an increase of active tissue such as a filling up of some thing although not dropsy.

This is rather confusing,-- the first case if this kind that I had I thought it was Bright's disease. This was more than twenty years ago and this disease was not clearly understood then. After a while I found a lady suffering from the same disease, and treated it successfully, and now it has been found that these cases of myxoedema or cachexia strumipriva are almost immediately relieved by the administration of two or three grains of dry thyroid once or twice a day, or at the most three times a day. In about three weeks such cases may be almost completely relieved by this means. This is very extraordinary. This has been the subject of most diligent inquiry on the part of physicians. Many physicians have devoted much time to research in reference to the thyroid and the effects of its removal. It has been found that when this gland is removed and a portion of it grafted into the thigh, or any other part of the body, no matter where, the harmful effects of this trouble disappear. It has sometimes been prepared by cooking. (Dr. Thomason: It is prepared by desiccation.") My impression is, that cooking impairs it. It should be perfectly desiccated when fresh, because putrefaction takes place easily, and if you don't do this you may poison your patient. In my practice, I had some patients who were made sick by the administration of thyroid that was not perfectly dry and fresh.

These are exceedingly remarkable facts, and they have led to inquires as to why the thyroid regulates nutrition; because when you find the nutrition not perfectly going on, and the skin becames thick and the brain affected when this gland is removed, it shows that this gland has wonderful

power to regulate the nutritive processes of the body. There are two principles or compounds in the thyroid-- one contains iodine, and the other resembles mucous, but it has been found that the mucous like substance is poisonous; it is highly toxic and produces decidedly poisonous effects when administered to animal, while in the iodine compound it is found that in those diseases in which an naimal is suffering from strumipriva, it obliterates the effects of this condition in it-s administration; so it appears that the good effects of the thyroid reside in the iodine compound, while the mucous-like substance found in the thyroid produces harmful effects. It is supposed that thr thyroid gathers out of the blood the poisonous substance resembling mucin, and it is supposed that the thyroid contains a ferment which destroys this substance, gathering out of the blood poisonous substance in the blood, and which result in the production of abnormalities of various sorts when left in the blood-- it gathers out these substances and destroys them; the thyroid actually gathers these substances together and then destroys them in itself, so it acts as a protector of the organism.

A further thought has been added, and that is that this ferment of the thyroid so changes and modifies the poisons which it gathers out of the blood that they may be thrown back into the blood again, and that it then furnishes materials out of which blood and brain cells are donstructed. This substance very closely resembles the colloid material found in the brain, both in chemical composition and in appearance, and which forms the gray matter of the brain. This explains the reason why, when the thyroid gland is removed or destroyed by disease, we have this fact not only manifested in the body, but also the individual failure in nutrition and development, and we have also a failure in mental activity because the brain is not furnished with nutritive material sufficient to maintain its structure intact.

We see why the removal of the thyroid gland of a boy or girl results in lack of proper development, for there is no proper development when the thyroid gland is removed; so we see that the thyroid gland is a wonderful regulator of nutrition.

I word in reference to the supra-renal capsules. These were first studied by Brown-Sequard-- he began with the supra-renal capsules more than forty years ago. When I was working with him more than a dozen years ago he told me of his earliest work. That was down in New York,-- his mother was an American, and his father was a Frenchman-- so he spent a part of his time in New York. He was one of the lecturers in the Bellview Hospital when I was a student in the winter of 1874-1875, and so I made his acquaintance and found him an extremely interesting man. He then told me of his early experiences more than thirty years before that time; but I will tell you a little more of his work respecting the glands later.

He began his work with the suprarenal capsules, and he made some remarkable discoveries. He found, for example, that in some cases a person might have no action of the kidneys, and yet remain in comparative health for some time, and might not show symptoms of poisoning for two or three weeks, while there was little or no secretion. He found in this case that the suprarenal capsules were intact, and so he supposed that they did something very essential in the way of destroying poisons. I have made further researches since his death which show that the suprarenal capsules have some important functions among which is the destroying of poisons. I took a portion of the suprarenal capsule and mixed with it an equal quantity of nicotine and made a solution, and found that the toxicity of the nicotine was nearly destroyed the same thing might be done with a solution of the liver. When a small portion of the nicotine has passed into the portal vein, its toxicity is nearly destroyed in passing through the liver. It has been found that it takes

twice as large a dose of poison to kill an animal after having passed through the portal vein this side of the liver as it does when pas-sing through the hepatic vein beyond the liver; I think Roger discovered that the suprare-nal capsules have the same effedt upon nicotine. But researches have shown that it is probable that the real functions of the suprarenal capsules is to destroy poisons formed in the muscle one characteristic of which is to lower the body temperature. The urine contains a number of different kinds of poisons-- have you studied Bouchard. (("No.") You should do so, because he deals with these facts, and he deals with living laboratory facts, and not with dead facts. Pathology deals with dead facts, but Bouchard deals with living facts, and these are what I like to talk about, and I hope you will get hold of them before you get through your studies. Bouchard's ob-servations have shown that there are seven different poisons eliminated , one of which raises the temperature, and another causes a wonderful fall of tem-perature. When determining the toxicity of the urine he found that the temperature of a rabbit would fall sever-al degrees, when the rabbit was in-jected with it the temperature of the rabbit would fall several degrees, but when he injected the rabbit with the urine of a typhoid fever patient the temperature of the rabbit rose five or six degrees above normal, and it did this within two minutes. I foundthe same thing in injecting a rabbit with the urine of a patient suffering from tuberculosis, and the rabbit quickly acquired a high temperature under the influence of it. There is also a poison produced in the body which causes a fall of temperature, and it is the duty of the suprarenal capsules to destroy these poisons. The poisons are are largely eliminated by the skin and kidneys, according to Bouchard, and when the skin is occluded by poisons so that it is impossible for the kidneys to eliminate them, these poisons are destroyed to a considerable ex-tent by the suprarenal capsules.

There is another important organ to be considered, the spleen--what does it do? It helps the portal circulation, and that of the lungs. It contains an internal secretion and what does it do? Among other important functions it accumulates blood-- it is a reservoir of the body; it holds back the blood from crowding into the liver. It produces a secretion which has an important influence upon the blood, but we don't know what. The spleen in enlarged before a meal, nobody knows why. It is probable that the spleen has an important work to do in controlling and modifying the soluble elements of thebody, as well as in manufacturing blood corpuscles. Does the splden make blood corpuscles? It is probable that they are formed in the spleen.

There is another important thing that the spleen does -- what is that? ("It destroys red cells.) Yes, and that is important, because these cells would obstruct the vessels if they should accumulate. But there is another thing that is important: the spleen seems to be a sort of lumbo into which parasites are cast. When you inject some typhoid fever germs into the blood the white corpuscles carry them to the spleen and they are kept there. If you will examine them you will see a white corpuscle arrest one of the these invaders and carry him off to the spleen as a constable a drunken sot or a disorderly person rioting on the steet, and carries him off and locks him up. So, in three hours after typhoid fever germs have been injected into the blood, every one of them will disappear. This is an interesting fact.

There is another thing which the spleen does, that is not so useful and that is, in a case of such a parasitic disease as a malarial infection. For example-- a malarial parasite seems to retreat to the spleen in some way-- I don't know how, but the spleen seems to be a sort of safe retreat for them where they hide away. It has been found in some cases to be advantageous to remove the spleen in persons suffering from chronic disorders.

in such cases, where the patient has recovered, the surgeon has removed the spleen and found that it has carried off the parasites as prisoners and kept them in jail until it set fire to them and burned them up. There is much that is not known about the spleen and there are some interesting things in reference to it which must be taken into account in dealing with the sick. We also have the thymus gland, which seems to have a sort of important influence in regulating nutrition. It is a fact that is not generally known , but it has been found that pituinary has some influence upon nutrition, and it has some connection connection with the thymus gland.

The sexual glands have a wonderful influence upon the body. The effects of castration in males and females, in changing altogether the character of development both mental and physical, so that the secretion of these glands is of immense advantage to an individual and that that is really one of their primary functions. Experiments have been made by Brown-Sequard upon this subjedt, and they were very conclusive. Experiments have made made in operations upon animals which were equally conclusive. The absence of the pituitary gland is one of the theories which has been advanced for the purpose of explaining macromeglay; and there are some remarkable tissue changes which can not be explained in any way.

TALKS TO JUNIOR MEDICAL STUDENTS. Dec. 12, 1901.

J. H. Kellogg, M. D.

Physiological therapeutics, (continued.)

We have been talking about internal defences; now let us talk about external protectives,-- the skin and its appendages. How does the skin defend the body? It is interesting to ntdice the character ofthe skin. Its structure contains a vast number of glands, and is covered with horny layers more of less impervious. There are two kinds of glands in the skin,- sweat glands or sudoriparous glands, and sebaceous glands; these glands are immense in number,-- how large is the skin? ("Seventeen sqare feet.") Some authorities have placed the figure a little higher-- it depends upon the size of the man or woman. An ingenious method has been devised for measuring the skin-- two methods have been devised for this purpose-- one method was to take a quantity of adhesive plaster of known length and width and then cover a man with it completely and then see how much adhesive plaster was left. If the druggist knows how much sticking plaster he has furnished and how much is left after the man has been covered with it, he knows how much has been used. A more recent and more correct invention has been made which consists of two wheels with a known circumference with a center with ink at the axle and a piece of blotting paper on the outside which soaks up the ink, and when the wheel passes over a given surface, it produces a double track with a known space between, and then one wheel runs on one line and the other whell makes a new track; then this wheel is rolled up and down the man until he has been all gone over. Then a simple reversion of the counter shows how great a distance has been traveled over. And knowing the area between the lines you can ascertain the surface of the body. We may also determine the number of square feet of the body by the application of a

well-known law of physics,-- that the surface is to the weight as the square of the cube root of the weight(?). So you can easily determine the surface after knowing the weight (by finding the three halves of the weight). A small man has a larger skin area in proportion to his weight than a large man-- but we will speak of that a little further on. I have had an opportunity to test the accuracy of this rule very thoroughly, and it has proven satisfactory,-- it comes within four per cent of the experiment which told you about. Of course there is a difference in symmetry sometimes, for a man with a small body has a larger skin area than a man with a large body and shorter limbs, so you must take that into account; but this is practically correct. Now suppose a man weighs 180 pounds and has a skin area of 21 sq. ft. as shown by this rule-- we will figure this out pretty soon, and we will find that we have but a small conception of the extent of the skin and of the enormous number and of the action of the blood vessels-- their surface if spead out covering more than ten thousand square feet, or more than five hundred times the entire surface of the skin,-- the actual surface of the skin and the actual surface of the skin which is presented to the outside is multiplied five hundred times by the enormous extent of the vessels and tubules of the sudoriparous glands.

These two sets of glands have an important relation to the protection of the body. The sweat glands, while they do not eliminate a great amount of solid substances, they do eliminate some. It is found that perspiration is toxic by injecting about 75 c.c.. of sweat(?) to a kilogram of rabbit, which would be about 2 1/2 ounces of sweat. Sherwin (?) and others have found that this amount of sweat would kill a kilogram of rabbit. I have made some experiments and found, as Sherwin has since shown that 75 to 80 c.c. of urine (?) would kill a kilogram of rabbit, so it seems that the sweat was not so toxic as the urine. However, the toxicity of the

sweat is modified by disease It is found for example, in cases of epilepsy and in cases of gout and rheumatism and various infectious disorders that the toxicity of sweat becomes enormously increased. In one case a Frenchman observer found the urine to be toxic in the proportion of 15c.c. per kilogram-- that 15 c.c. of urine would kill a kilogram of rabbit; thatis a very high degree of toxicity. Sweat ordinarily contains a little urea and in rheumatism and gout it may eliminate a large amount of poisons and it has been found in infectious disorders, as in smallpox etc., that the sweat becomes extremely toxic. So you see tht one of the means by which the bodyis defended by carrying the poisons out of the body through the sweat glands.

The sebaceous glands also protect the body by eliminating certain acids, as butyric acid, etc., and they help to diminish the tendency to diminish the alkalinity,-- they help to maintain the alkalinity of the blood upon which the defensive powers of the body are so intimately dependent. Sometimes the sebaceious glands contain a large amount of acids. When acids are formed in the stomach, as butyric acid fermentation, the sweat glands are found to contain a large amount of acid, and I have sometimes thought that this was the cause of acne; I have often found persons subject to acne who were in the habit of eating alarge amount of butter; that in some cases where a considerable amount of butter was eaten there would be a breaking out of acne in the face. This is expecially the case with children who are more subject to attacks of germs than are adults, as they have thinner skins and have less resistance of the body . In such persons we have found that the use of butter is likely to produce acne or pimples. I think that this was due to the production of fatty acids and that they lessen the resistance of the tissues so that the germs that were present obtained a foothold.

Some of these things which I am presenting are new to you because they are not found in text books, but they have been worked out by ob-

servers, and furnish a solid foundation on which you can stand. I want to say to you that the slavery of opinion is one of the most awful slaveries to which human beings are subject and it is a great hindrance to progess, when we feel that we dare not think differently from others. I hope you will dare to think and if you have good reasons for thinking differently from others I hope you will dare to to step out on that new line of thought no matter if it is opposed to others, if it is true. You are not to be slaves to opinion but you are to be slaves to truth. You should feel compelled to believe the truth that impresses itself upon your mind.

Another interesting fact in relation to the skin: the fact that different parts of the body seem to have the power to accumulate toxic substances and the exudates of the glands which are actively secreting substances which are sometimes repulsive in odor, in some persons are very marked. We must believe that through these channels certain toxic substances are being eliminated.....

It is interesting to notice that sweat is obnoxious to germs. You collect a quantity of perspiration and put it in a test tube and plant some germ in it-- for instance the germ of-- I can't pronounce the name now-- and it won't produce any coloring matter as it usually does. Some time ago we had some of these germs which we found in a man's stomach and we had some interesting experiments with them. It would produce coloring matter at first but when it mingled with the air the color would disappear.

We may believe, then, that the secretion of perspiration is one of the means by which the body defends itself against germs, from the fact that the secretion itself is obnoxious to the germs. There is a constant outward movement of the perspiration which prevents the germs from creeping down into the ducts and net work of the vessels of the body, and so keep the pores free.

There is some thing, perhaps, in the popular idea that the pores may become obstructed by the sebaceous matter but the movement outward is a protection.

Then there is a sort of protection afforded by the fat which serves the skin as a varnish and serves to render the skin impervious to germs, which are always found upon the skin,-- staphylococcus pyogenes aureus and other germs are present, and in the case of a wound the skin is protected against these germs by the pus that is formed beneath that and is a protection against them. So you see how much truth there is in the popular idea, that when a man has a wound and it does not heal quickly, that his blood is bad. Every one says that when a man's blood is good, and he has a wound, it heals quickly,-- and there is a scientific reason for that-- and that is that the tissues are able to resist the germs, and have a higher power of resistance even when exposed to germs even those tissues which are protected by a thin layer of skin. It is a wonderful thing that we have this horny layer of skin which is at the same time impervious by reason of the varnish of oil or fat,-- so much so that you can put your hand in a solution of strychnia without great danger, while one-tenth part of that solution when exposed to the mucous membrane of the mouth would be deadly. But the hand, and the whole surface of the body may be exposed to this poison without serious injury. Caustics when applied to the skin find their way only a little way in because of the resistance which is continually set up by the skin. One may come in contact with a number of things which are hrmful, but so long as there is a little layer of skin present it is a protection against germs, parasites, and most insects,-- although it is not a protection against the mosquito. The mosquito is provided with a hypodermic syringe by which he makes his puncture in the skin. The same thing is true of the bee also which has power to administer a hypodermic injection.

When we see how much we are exposed, and yet see how intact the body is preserved by the skin, we must wonder at the providential care whichhas given us such a protection. And yet this same skin, when covered with varnish would render the skin impervious to air and so the skin would lose its function and death might soon occur. The functions of the skin would be practically annihilated for the time being. When the skin is in this undesirable condition something happens-- can any one tell me what it is (" in one instance, death occurred.") One of the first things that happens is an appearance of albumen in the urine which is likely to occur in a chill. When a man has malarial fever and has a chill he has albumen in the urine, and it may remain there.

Another thing that happens in this condition, is that the blood corpuscles are destroyed and the coloring matter appears in the urine. The breathing capacity is also diminished and the functions of the lungs disturbed, and death occurs. The temperature falls, perhaps, as Bouchard suggests, through the retention of certain poisons which are normally carried off principally though the skin,-- the temperature-lowering -poisons which are largely generated in the muscles.

Q. Is an increase of the alkalinity of the blood beneficial?

A. The blood should have its normal alkalinity; I think it would be difficult to get the blood too alkaline.

It is an interesting thing that tears, which are connected with the skin are also protectors and germacides. Itis impossible, as a general rule, for any deadly organism to come in contact with and destroy any living body. When you see a healthy tree growing in the woods or orchard, standing out in the light and sunshine, you do not see any moth, mold nor fungi growing upon it-- you do not see anything of this kind growing upon a healthy apple tree, pear tree or other healthy tree. If you see fungus of any kind

growing upon a tree what do you call it? ("That it is notin a state of goo nutrition.") Yes. When you find a human being with a fungus growing upon him, or in him, it is evidence of the beginning of deterioration. If a man hapsoriasis it is an evidence of deterioration; the same this is true of de cayed teeth. I am proud of my teeth. I once showed a tooth to a scientifi dentist, and he afterwards said there was no decaying process going on in teeth-- said he to me, "Your teeth are sound and they will last you many years," so he let the tooth alone; it had been broken off but there was no disease process at work, as the dentist told me,-- and that was a good poin for me, for I knew now from that fact, that I am able to hold off germs, so far as the teeth are concerned. And sound teeth is one of the best indications of a sound body-- when decay of the teeth begins, then decay of the body begins. Decay of the body generally begins with the bones, and when v find the teeth of a race, or family, or of a man, disappearing that is a positive evidence that deterioration of that man, or race, or family has beg The best such a man can do is to keep himself in fair condition; he has not power to endure very severe tests, he may be able to enjoy health under fa conditions, but you may bring him to severe tests, and he will fail; so this is an evidence of deterioration.

There are some other protectors in the skin: we are protected fro the chemical rays of the sun which would have a very injurious effect if were not properly protected,-- for instance, a person has long been accustomed to live indoors and he goes out doors and works in the sun and he soons b comes giddy and seeks the shade. Farm horses also suffer in this way. I ticed as I was leaving Mexico that the horse wore hats or bonnets, similar to ladies bonnets,-- I noticed the same thing in Chicago, and the horses looked nice in them. It is a beautiful thing to take care of horses in that way;

more work can be gotten out of them when properly cared for. A man or a horse who goes out in the sun to work and who is not accustomed to it is liable to sunstroke, because of the deleterious effects-- not from the heat rays, but from the effects of the chemical rays. But we will talk about that when we come to talk about phototherapy.

It is the effect of the action of this same chemical ray which gives rise to what is called "sunburn". Sunburn is not a burn,-- it is an erythema or inflammation. If you burn yourself by any kind of fire you know it right away by the smart, but this is not the case with sunburn-- you do not recognize the pain caused by it until sometime afterward; it is a erythema or in flammation set up though the exposure of some part of the body to the chemical ray. This is the ray that is utilized in making pictures. This ray is found in the violet rays of the spectrum and to some degree in the blue,-- but there are other rays outside of this-- there are ultra violet rays which are given off by certain substances, for example, chloride of barium. A chemist made use of this in Paris sometime not long ago; he put some of it is a glass tube with a piece of photographer's printing paper. He put it in a dark place at night and left it there over night, and found that he had a regular print the next day. He carried a piece of this substance in his pocket, and found that it was luminous and that X-rays were given off by this substance.

The skin affords protection against mechanical and chemical irritation by the fat, and there are pigments which are a protection against the chemical rays. The chemical ray attracts heat. If you put a a piece of black cloth upon a block of ice and put a piece of white cloth upon another block of ice, which will go down into the ice first? ("The black cloth.") Yes, because the black cloth absorbs the rays, but the white cloth does not, it reflects them. So the black man, although his skin is thicker than that

of the white man he is protected by his black skin from the injurious effect of the chemical ray. The reason his skin is black is, because he lives in a hot climate, and his skin becomes darker and darker and darker. That is the reason his hair is so very think-- so that his head may become impervious to the chemical ray. Negroes living in cold climates are apt to become tuberculous, and they do not seem to be able to resist the cold as well as those whoare accustomed to live in cold climates. Then you ask, "Why does the Esquimaux have a dark skin?" For the same reason-- the strong light reflected from the snow and ice has the same deleterious effects an the sunlight; the intensity of the rays is less than hot countries, but the multiplication of the rays of light from the snow and ice has the same effect as great exposure to the rays of the sun.

Alpine travelers suffer from sunburn when they get about ten to twelve thousand above sea level,-- they suffer sunburn from the reflection of the light from the snow and ice. (Dr. Thomason: Even when the sun was not shining very brightly.) Yes; I had an experience of that kind myself once while climbing Rike's Peak. There was plenty of snow up there and I went up on the outside of the wagon and the ear that was exposed to the light from the snow and ice was sunburned and the other ear was frozen, so I had a hot and cold application simultaneously.

Another interesting fact in reference to the skin as a protector under certain thermic conditions,-in proportion to the area of the skin,- we will take a man weighing 180 lbs-- suppose he loses 50 pounds, and he weighs only 130 pounds-- how much skin area will a child have who weighs 30 pounds? (Not understood.) You will sometimes find a patient who has occasional attacks of albuminuria and he has a tonic application of water, as, a shallow bath, and a few days afterward you find the urine has albumen in it, and the patient says, "I am getting worse." It is important to know

that the shallow bath was not the thing for him. The patient might ask you, "Can I take cold baths, Can I go into the plunge? Can I go in for a swim?" And you might say to him, "You may take a little dip and come out again after you count ten; then he exposes himself to the sun until he gets a slight reaction. The he stays in long enough to get the skin chilled and the viscera congested; the kidneys will begin to become brimful of albumen, and perhaps this congestion may set up inflammation and nephritis,-- we may have nephritis without germs and we might have inflammation set up without having an attack of germs upon the kidneys. Nephritis perhaps involves the action of germs, but the beginning of the disease is a congestion which lowers the powers of the kidneys to resist the toxic germs-- the lowering of the resistance at the start is the real foundation of the disease. They have power to resist the action of germs until the resistance is diminished.

But we are considering the defences of the body through thermic agents. The skin has a radiating surface, although a considerable amount of heat is lost by evaporation,-- let us see if we can find how much is lost in this manner. Let us see if we can tell how many heat units of energy are consumed in the body in a day. What is the total output of energy in twenty four hours? ("Two million three hundred thousand.") What is a calorie? (""One degree Centigrade.") (Blackboard calculation.) So this man would do ten thousand heat units of work in a day. How much energy would be given of by evaporation or perspiration-- how much sweat in an hour, or how many c.c. in a day? ("Two thousand.") We will say three ounces in an hour-- how much energy would that man expend in evaporation from sweat in thwenty-four hours (Calculation on blackboard.) How many square inches of skin would this man have to a pound of weight, ("Eighteen.") Let us see how much a boy weighing thirty pounds would have-- thirty ounces. We see that a man who is fat has a smaller skin surface in proportion than a lean man, so he is

more exposed to cold. Fat has less than half the conductility of muscle. Fat is a sort of overcoat, so that if a man's fat disappears beneath his skin he has lost his overcoat, and so his is exposed to cold to a greater degree than before; but at the same time he has a larger heat radiating surface in proportion to his weight. We find that a boy weighing thirty pounds would have about twice the skin capacity in proportion to his size, as the man weighing 180 pounds-- so the boy must eat approximately twice as much as the man in proportion to his size, if 4/5 of fat is expended in heat he would have to eat about 4/5 times as much as the man in proportion to his size. Besides the boy's activity is greater than that of the man. The rations of a boy weighing 30 pounds must be at least a quarter more than that of a man.

Now in regard to the protection of the body: the body is continually exposed to this loss of heat, and it follows the regular law of radiation A man who is out of doors and unprotected, radiating heat under an open sky, loses more heat than a man who is shut up in a room. A tree is a great protection from the heat. Why? Because the rays of heat radiating to the tree from the body radiate back to the body from the tree, whereas if one is exposed to an open sky, the hat rays that are given off by the body, never come back.....

How much does the body lose by evaporation? Here is a boy losing three ounces in an hour,-- how many pounds in an hour-- about 4 1/2. How many heat units does that represent-- practically a thousand heat units. It takes a thousand heat units to convert a pound of water into steam-- how much will this represent? Four thousand five hundred heat units are lost by evaporation in breathing three ounces. What proportion of the total number of heat units is the proportion expended for the total output of energy in a day? ("Ten thousand units.") I stick to the English heat unit

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because it is easy to remember and it gives us round numbers, and they are easy to remember, and you can always convert these into calories by dividing by four. Almost half the temperature, or heat of the body, at this rate, would be lost by evaporation alone, saying nothing about radiation; this is a very large amount-- about how much is used in work? ("About 1/4.") Yes about 1/4 in work, 2/4 in evaporation, and 1/4 by radiation. Suppose a person or an animal does not sweat-- like the dog-- does a dog sweat? ("NO.") How does he radiate his heat? ("By breathing.") He has a very think fur or skin-- how can he radiate through it? ("By his breathing.") He sweats through his pulmonary mucous membrane instead of through his skin. There are several animals that do that-- does the horse sweat? ("Yes.") Yes, but a dog does not sweat; he throws off water from his lungs-- is that a evaporating surface? ("Yes.") A dog breaths in this way (Illustrating.) He breaths in this way because he is blowing upon his lungs, so to speak, in order to promote evaporation, as when you burn your hand or finger, you breath upon it in order to promote evaporation and cool it. The wind evaporates moisture from the face and cools the face; so when a person is exposed to a draft, he finds that evaporation will be promoted by a large amount of air. If you will moisten your finger nail, the finger-nail being sensitive to cold, and then move it through the air, you will find this side becomes distinctly cool. So when a person has taken a bath and walks along through the hall afterwards it has the effect of a draft in the hall; I have heard persons make the remark that they experienced a draft in the hall after taking a bath.

Suppose the temperature of the body falls below the point which it should reach-- what happens? Here is where the skin protects us again. We see how the body is protected from excessive heat by means of the sweat glands which promote evaporation. How much sweat may one produce in an hour?

("Four pounds.") I wish to find out the maximum amount of moisture which can be evaporated upon the skin per hour; I wish you would look that up and report. Now suppose the temperature begins to fall-- what is the first thing that happens? The blood vessels-- but let us consider it the othr way-- there are two things done, when the temperature begins to fall or to rise too high: If the temperature is likely to rise too high, nature fills the skin with blood, dilates the blood vessels of the skin and pours out perspiration; the blood vessels are dilated so as to bring the blood into the skin and it is spread out to be cooled, and the moisture is poured out to be evaporated over the thin layer of blood which is cooled. See how beautifully these two things are combined-- the opening of the blood vessels and the cooling of the blood, sprinkling the vessels and cooling the blood. So you can see evidences that a Divine Intelligence is watching over us. So how incessantly changes occur,-- they are taking place every moment both day and night; you wake up in the night and find yourself perspiring so as to cool yourself by evaporation, because the air is too warm. We have no care in regard to perspiration, but it is an Intelligent Being who has cause this to happen so that injury may not result. Now suppose the temperature falls too rapidly so tht you have an excessive loss of heat-- what is the result? ("Chill.") And that chill may come either as a reflex effect, or through the centers themselves. There are certain centers in the brain, and the chill center is located in the region of the fissure orlando, the highest of the motor centers. Chill is an important function of the body; it is an automatic thing. When the temperature falls too low you shiver, and presently your hands and limbs and jaws shake, and you find yourself shaking from head to foot; it is automatic and there is no power to control it. This is wonderful. In the first place, in connection with the chill there is a contraction of the blood vessels of the skin; this shuts off the

loss of heat; then the muscles are set to work to produce heat-- by the way, the muscles produce 2/3 to 3/4 of all the hat produced in the body. so you see the consequences of setting all the muscles of the body to work..... The muscles keep up their vigorous vibratory mation, and when the muscels are at work in this way they produce a great amount of heat, by their continual lifting movement.

Another fact on this point: When the muscle lifts, the energy goes into the work, but when the muscle contracts without any work, where does the energy go? ("Into heat.") Yes, the energy is converted into heat. That is another illustration of the marvelous economy, and the wise administration of the affairs of the body. Whatever chemical work we do is energy expended outside of the body. ("Is heat produced in the body?") It is a transformation of energy. We must remember that in chill there is a wonderfully reduced resistance of the body. What evidence have we of this? In the purple lips, and a deficient oxidation taking place in the body, which causes asphyxiation of the cells; it is like the asphyxiation of an animal-- the power of resistance is lessened, and they are more subject to attacks of microbes of various sorts. A chill might be the result of a reflex action. Whenever the temperature of the blood circulating through the skin is lowered to such a degree that the nerves are chilled to a certain point that is fixed by each individual case, then the chill is reflexly incited, in order that the individual may be warmed up. The body-centers receive notice that there is danger from too great a loss of heat. A chill in induced by a general lowering of the temperature of the body. On the other hand, we may have a lowering of the temperature of the blood, and notice is sent out to the muscles to begin a vibratory contraction of the muscles by which heat may be produced. Again we may have within the body certain toxic substances such for instance, as is produced by malarial fever by the malarial

parasite,-- also in tuberculosis and various other diseases there are several toxic substances which when they come in contact with the chill center in the brain stimulate this center and set up the phenomena which accompanies chill.

Chapter on Therapeutics, etc continued. Dec.9, 1901.

THERAPEUTIC APPLICATIONS:-- The sun-bath, with the concluding hydriatic application always connected with it, is one of the most powerful and effective of all therapeutic means which can be brought to bear upon the human organism. There is no means by which metabolism may be more profoundly influenced than by the combined action of the thermic, and chemical rays of the sun followed by the powerful stimulus of the cold douche or some other appropiate cold application. The sun-bath has been thus employed as a curative measure from the most ancient times,-- in fact its use is not confined to human beings. A natural instinct seems to lead the lower animals, and savage men, as well as civilized men to resort to this means of quickening the natural recuperative powers of the body in cases of disease.

The sun-bath is applicable in all forms of chronic disease accompanied by slowed nutrition, in all forms of disease accompanied by defective metabolism, especially in the diatheses in which there is deficient oxidation, as in obesity, diabetis, and the uric acid diathesis. They dry, sallow, leathery skin of the chronic dyspeptic affords an exevidence of the profound autointoxication present, and rapidly becomes moist, lively and velvetty, as the result of an hours daily sunning.

Neurasthenia, in all its forms, is radically helped by improvement of the quality of the blood and all the tissue building processes. In anemia and chlorosis, the blood making processes are encouraged, toxins are eliminated, and the spasm of the cutaneous vessels which results in chronic visceral congestion, is rapidly removed. In myxoedema, exophthalmic goitre this remedy is of great value when employed with proper precautions. In Bright's disease, hepatic cirrhosis, and in all other forms of visceral degeneration, patients often see surprising benefits from this simple measure when employed with proper caution. In chronic rheumatism, rheumatic gout, and even in

tubercular joint disease the sun-bath often accomplishes wonders, always affording amelioration, and sometimes aiding the patient's recovery in cases which sometimes seem hopeless.

Wintermitz recently called attention to the great benefits which may be derived from exposing the skin to the sun in various cutaneous disorders, especially eczema. He covered the skin, first, with a red cloth, and then exposed the parts thus protected to the influence of the full solar ray for hours daily. The writer has found equal success in many cases of chronic acne of the face and shoulders. Psoriasis also yields to this methdd.

Chronic tuberculosis, chronic bronchitis, tertiary syphilis, chronic indigestion-- either with hypopepsia or hyperpepsia, chronic disease of the spinal cord, even when accompanied by trophic changes in the related parts, in hysteria, melancholia, and in fact, almost every chronic disease is, to a marked degree, benefited by the systematic and intelligent employment of the sun-bath.

CONTRA INDICATIONS.-- The sun-bath is contra indicated in all febrile disorders, except in those cases of chronic pulmonary disorders in which there may be a slight elevation of temperature. Decided febrile activity, however, should always be regarded as contra indicative of general sun bathing, or as necessarily limiting the exposure of the sun to a very few minutes, the exposure being long enough to increase the elevation of temperature. It should be remembered that in cases of this sort the thermotaxic functions of the body are disturbed and an elevation of the temerature is very easily induced. In eruptive fevers, especially in smallpox, the chemical rays should be altogether excluded. This is best accomplished by hanging very heavy red curtains before the windows of the sick room. Finsen, of Copenhagen, and others, have shown that this precaution prevents the

formation of pus tubes and greatly aids recovery.

In cases of insomnia, great care must be taken to avoid overheatir the brain, and the cold application following the bath should be very short In cases of rhrumatism, gout, and rheumatoid, arthritis, the cold application from the sun-bath must not be too intense nor prolonged. It is often better to cool apatient, especially at the beginning of a course of treatment, by a tepid shower or fan douche or the broken jet. The temperature should be from 85° to 75°, and the duration, twenty to sixty seconds. Care must be taken to avoid allowing the stream of cold water to fall directly upon the affected joints, as this will increase the pain.

In cases of cardiac disease, in which there is marked evidence of failing compensation, prolonged exposure to the sun should be avoided, and the succeeding cold application should be very moderate in character, the temperature not being lower than 60°, and the duration from ten to twenty seconds. If the cold application in in the form of a douche the precordial region should be avoided and the legs, the back and the liver should receive chief attention. In these cases, however, it is, as a rule, better to cool the patient by means of a cold towel rub, or the wet sheet rubbing. When skin eruptions are present, very cold application and friction should b avoided. The patient may be cooled by a prolonged rain douche at 85° to 78°. Reaction should be promoted by exercise after the bath rather than by friction.

ELECTRIC LIGHT BATHS.

Localized applications of sunlight are commonly made by means of lenses are concave mirrors by means of which the sun rays may be concentrated The writer first employed the concentrated rays of the sun in this manner in the summer of 1883. It was then successfully used in the treatment of a cases of inveterate neuralgia of the posterior branches of the spinal nerves and later, in various other classes of cases. Experiments have shown that these concentrated rays have a marvelous penetrating power; it is poss-ible to make a print from a photographic negative by applying thenegative and a prepared paper with complete seclusion to the back, and then throwing the concentrated sun's rays upon the chest of the subject. The accompanying cut shows prints made in this way.

In these local applications of the concentrated solar rays, the chemical ray must be regarded as the active agent. The principle embarrassment which arises in the employment of concentrated light is the great intensi-ty of the calorific rays which render the application intolerable after the first few seconds. Finsen first succeeded in overcoming this difficulty by filtering out the calorific and luminous rays by passing the solar ray through a blue solution may by dissolving sulphate of copper in water and adding aqua ammonia. In this solution, the strength of the solution em-ployed is grams of sulphate of copper to a liter of water to which is add-ed fluid drams of aqua ammonia. The strength of the solution may be varied to suit the intensity of the sun's rays at different seasons; it should be just sufficient to reduce the heat to a degree which the skin will toler-ate when the rays of the sun are brought to a focus on the skin, the purpose being to obtain the highest degree of activity of the chemical rays while

suppressing the action of the heat rays.

In order to still further increase the influence of the chemical rays, Finsen found it expedient to compress the tissues, thus emptying the blood vessels and rendering the structure of the skin nearly transparent, experients having been shown that the opacity of the tissues is chiefly due to the presence of the red corpuscles. This compression is accomplished by means of a glass lens which Finsen has also made to act as a refrigerant of the tissues by making the lens hollow, and passing through it constantly a stream of cold water, thus making it possible to employ a higher degree of concentration of the sun's rays than would otherwise be tolerable. The writer has, in emergency, accomplished the same thing by a very similar but less practical means,-- an ordinary lens about six inches in diameter was employed to concentrate the solar rays, which are allowed to fall upon the skin after passing through a block of ice an inch in diameter held upon the skin. The ice serves a triple purpose,-- (a) emptying the blood vessels and blanching the tissues; (b) cooling the tissues; (c) filtering out a large part of the heat rays. In the absence of more convenient compressant means, ice formed in any shape desired may serve a useful purpose as an emergency method. The accompanying cut shows the apparatus employed by Finsen in the use of the solar rays. Fig. shows the apparatus by means of which the rays obtained from the arc light are employed.

TECHNIQUE.-- The duration of the application is from an hour to an a half. The patient suffers no pain during the application although there is sometimes itching. The surface treated reddens during the seance, and a few hours later the tissues may be slightly swollen. Twenty-four hours later, a bulla filled with clear serum usually appears. In a few days these is dry, leaving thin crusts which are readily removed. By means of dressin moistened with a solution of boracic acid, a sloughing never occurs. The

phenomena is simply that of an intense sunburn. At the end of eight or ten days the application may be renewed.

THERAPEUTIC APPLICATIONS.-- The actinic rays have been employed by Finsen and others in the treatment of various forms of lupus, epithelima and several varieties of acne, alopesia, and other maladies of the skin. This method has proven to be perfectly successful in lupus vulgaris.

When visiting the Life Institute of Copenhagen in '99, the writer was informed that benefit has been derived from this treatment in nearly all cases, and that failure had occurred only in cases in which the patient had not remained under treatment for a sufficient length of time. Interesting note was also made of the fact that better results were obtained during the summer season when the patients were treated by the solar rays than during the winter season when the treatment was administered indoors by the aid of the arc-light.

The success obtained in the treatment of epithelioma of the skin was also highly encouraging, nine cures being obtained out of eighteen cases treated. Of twenty-nine cases of alopecia areata, twenty-two were cured. None of the rest were discharged as incurable, and some were obliged to discontinue treatment for various reasons.

The treatment of lupus by this method, must be employed perseveringly. Finsen found that his patients remain under treatment on the average about four and one-half months. In some cases two or three applications affected a cure while in other cases in which the disease covered a considerable degree of territory, the applications must be repeatedly made to each part before a permanent cure is affected.

It is well to note that a cure is affected by a destruction of the tissues, a destruction of the parasitic elements upon which the disease depends, and a quickening of the vital activities of the tissues

whereby their power of defence in increased. Leredde reported the successful treatment of psychosis by the application of the chemical rays. Amelioration was found to be very marked at the end of six weeks, the patient receiving two applications each week.

The accompanying cut shows the results which may be obtained in the treatment of lupus by this treatment. Fig. represents a case recently treated under the supervision of the writer; the others are figures of cases treated by Finsen. The writer can testify to the truth of the representations made, having personally inspected a number of the originals at Finsen's establishment in Copenhagen.

There are no dangers whatever in these local applications of the solar rays. The necessary apparatus for the application of the solar rays is very inexpensive, the only inconvenience attending its use is the considerable length of time required.

THE ELECTRIC LIGHT BATH.-- The electric light, as has been previously shown, possesses properties perfectly identical with those of the sun's rays, in the arc-light the luminous chemical rays being dominant, while in the incandescent light, the heat rays are dominant.

The difference in form, of the arc lamp and the incandescent lamp are the decided difference in the quality of the light obtained from these two sources, naturally divides the devices by which these two forms of light are utilized therapeutically, into two distinct classes. In the earliest forms of the arc-light bath, a single arc lamp was employed, a reflector was placed behind it, and it was so arranged as to focus the rays upon the back of the trunk. Baths of this sort were employed, though not scientifically, in the United States, twenty years ago, and for a shorter time in France. A scientific study of the electric light, as far as the writer is

aware, began with his own observations in '91, when he had constructed various forms of the electric light apparatus, at first employing incandescent lamps, later arc lamps also.

The arc light, while affording much more powerful rays than those obtained from the electric light, is not, thus far, proven to be so useful for general purposes as the incandescent light. Its bulk, and expense attending its installation and the numerous inconveniences attending its employment are perhaps sufficient reasons as to why its use has thus far been quite limited. For general application, the writer has found most convenien an apparatus which he has had constructed for the purpose, and which consist of a square cabinet of such shape and height as to permit the patient's head to be excluded from the bath while he sits erect upon a stool in the center of the cabinet, a recess being provided at each corner, in which is placed a powerful arc-light arranged in such a manner that it may be adjusted to any level. Its construction is imperfectly shown in Fig. . The recess is lined with aluminum, or nickle-plated copper, so as to direct the rays toward the center of the cabinet. Mounted glass screens are attached by hinges at either side of the recess, so arranged that either a red or a blue screen may be interposed at will, between the lamp and the patient. By this means it is best to employ the unfiltered rays, or the chemical rays exclusively, or the calorific rays alone. When the chemical rays are required, it is only necessary to interpose the blue screen, while the red screen allows the passage of heat rays only. The recess containing the lamp is open at the top and bottom, so that, by a free circulation of air, the heating of the glass screen, and consequently the heating of the air, this cabinet may be, so far as possible, protected. The cabinet itself is also freely ventilated, so that the effects of the bath are practically confined to the direct influence of the electric light rays.

PATHOLOGICAL EFFECTS.-- The results obtained by the employment of this bath are essentially the same as those obtained from the sun-bath. The arc light is practically the same thing as the sun bath. It exercises the same influence upon vegetation. It is capable of producing solar erythema, and, for therapeutic purposes may be regarded as actual sunlight.

Patients exposed to the influence of this bath begin to perspire much more quickly than when exposed to ordinary sun-bath. This may perhaps be due to the greater number of actinic rays in the arc-light exercising a powerfully stimulating effect upon the perspiratroy glands. A short application of the bath is highly toxic in its effects. A prolonged application produces exhausting effects, similar to those observed from the prolonged sunbath. The duration of this bath may be from five to twenty minutes. The therapeutic indications are precisely the same as those of the sun-bath The measures decribed as suitable for employment in concluding the sun-bath are equally applicable for use in connection with the arc-light, and the remarks made respecting precautions and contra indications are equally applicable.

LOCAL APPLICATIONS OF THE ELECTRIC ARC-LIGHT.-- Our knowledge respecting the value of the arc-light as a local therapeutic measure, and the methods employing it are almost wholly due to the inventions and observations of Finsen, who, after demonstrating the value of actinic rays of the sun in the treatment of lupus and various other maladies of the skin, show that the same results may be obtained by the employment of the arc-light by the addition of suitable devices. For a full description of the apparatus employed, the reader is referred to a French translation of Finsen's work *(Make foot-note for references.) Various decriptions have also been given in the American periodicals* (Make foot-note for references.)

The accompanying cut gives an external view of the local light employed by Finsen, enclosed and furnished with four sets of condensers

each of which serve for the treatment of a single patient.

THE INCANDESCENT ELECTRIC LIGHT.-- Aside from the sun-bath, the incandescent electric light is one of the most useful and generally serviceable of all the measures employed in phototherapy. Various appliances have been devised for both general and localized applications of the incandescent electric light. The first of these were constructed by the author in 1891, and consisted of simple measures for applying the electric light to small areas. The very first consisted of a mental cone of polished mental to be a foot in length and ten to twelve inches in diameter at the base. In the apex was fixed a single electric light, with socket in which could be fixed a lamp of any candle power required, from eight to fifty. In use, the cone was placed over the abdomen, hhe chest, a joint, the back, or any other part to which it was desired to make an application. The good results obtained were so great that other devices for applications to special parts, as the spine, the trunk, the feet, and the joints, were rapidly constructed, together with arrangements for applying the light to the whole body.

The first device for accomplishing this consisted of a frame about two feet in width and six feet in length, upon which was supported a metal reflector with incan-descent lights and with twenty to thirty incandescent lamps. This frame was hinged at a support in such a way that it could be raised and lowered. A couch was placed beneath it, and on this the patient lay down. Then the frame bearing the lights was lowered to within a few inches of the body and the lights turned on. After the application had been made to one side of the body for a sufficient length of time, the patient tuned over and received the light upon the opposite side.

A littlelater, a cabinet was constructed,-- first a vertical, and then a horizontal cabinet. The accompanying cut (Fig.), shows the form of the vertical cabinet first employed. Other cabinets of various forms and

sizeshave since been constructed by the author and numerous others who have interested themselves in the development of these new therapeutic measures, particularly Prof. Winternitz of Vienna. A horizontal cabinet constructed by the author, and in use in various institutions, is shown in Fig. . In this cabinet the patient lies upon a movable couch which may be easily run in and out of the cabinet, the cabinet being mounted on wheels for this purpose. The couch is provided with a think glass top beneath which a number of electric lights are placed so that the under surface of the body is exposed to the influence of the light, as well as the upper surface, making it unnecessary for the patient to change his position in order to secure a thorough exposure of the skin to the influence of the light. A small vertical cabinet constructed with the head excluded, carries twenty to forty lamps. The horizontal cabinet contains twenty lamps of sixteen candle power each. Figs. , , , show other devices for applicationsto the spine, trunk, feet, and joints and other parts of the body. In figs. , and are shown cuts of means of making localized applications with the electric light which are quite extensively in use in France and England, where the bath is coming to be generally employed since the publication of the description of the author's devices and observations, in German and other medical periodicals.

TECHNIQUE.-- For the application of the general incandescent electric light bath, the patient's clothing is removed just as the patient enter the bath, care being taken care that the feet should be warmed, and the head face and neck cooled in the preparation for the bath. The intensity of the bath is regulated by means of suitable switches which determine the number of lamps in use, which render it possible to increase of diminish, at will, the number of lights, and hence the intensity of the application. The has also employed a rheostat for the same purpose, leaving all the lights

in operation all the time, but controlling the intensity of the light by means of a suitable rheostat. The duration of the bath must be determined by the effect desired. If tonic effect alone is required, the duration may not be more than three to five minutes. If it is desired to thoroughly heat the skin, then the patient remains in the bath until the skin becomes slightly moist from increased perspiration. If eliminative effects are desired, the patient remains in the bath until vigorous perspiration is produced, and until the perspiration has been continued for the desired length of time.

In cases in which the application is considerably prolonged, and ice-bag should be placed over the heartt and a cold wet napkin should be wrapped about the head, or the head and throat, and this should be renewed as often as it becomes warm. The temperature of the bath may range anywhere from a 150° to the highest temperature tolerable. It should be remembered that in this bath the heat is not derived from the air, as in the hot air-bath, but is communicated to the body by means of the hear rays or radiant energy thrown off by the incandescent filaments within the lamps. These rays pass through the air surrounding the patient without heating him to any very considerable degree. As the rays rays enter the body they come in contac with various opaque structures, the resistance afforded by which, converts the radiant energy into heat, hence the temperature of the air surrounding the patient is a matter of very little consequence . It is important that the bath should be well ventilated so that the moisure arising from the patien t's body may be rapidly carried away. The dryer the air, the higher the temperature the patient will be able to bear. Some french observers report the employment of temperatures ranging from 400 to 500°. These authorities emply, in taking the temperature of the body, a thermometer, the bulb of which has been covered with lamp-black, and which is fully exposed to the light, being

usually placed upon the patient's body so as to be at the same distance from the lights. Superheating of the air about the patient might be practiced when desirable, by simply confining the air space within the cabinet. It is then possible to conbine the hot air bath and the light bath. Care should be taken in the treatment of patients whose eyes are sensitive to the influence of a bright light, to protect them by means of a napkin laid across the eyes, or by suitable colored glasses.

The after treatment to be employed in connection with the incandescent electric light bath, or radiant heat bath is precisely the same as that employed after the arc-light bath or the sun-bath.

A cold application should be made in almost every case. The only exceptions are those in which cold is contra indicated. General applications must be made after the general electric light bath, and after local applications the cold application should be made to the parts which hve been exposed to the action of the light and heat. For local applications, the douche and cold towel rub are most satisfactory and efficient measures. (Insert note.)

PHYSIOLOGOCAL EFFECTS.-- Beginning in 1892, I have conducted, at various times, a series of experiments for the purpose of determining the physiological effects and the precise therapeutic value of the incandescent electric light bath. These results I may briefly summarize as follows:

1. The most important property of the electric light bath is that of a very superios heating agent. It is stated on good authority that a very large part of the energy expended in the incandescent light is converted into heat, only about five per cent appearing as light. Its chief therapeutic value is found in its use as heating procedure.

2. A strong, or a considerably prolonged application of electric, whether local or general, produces intense reddening of the skin with dilitation of the surface vessels. Its affect, in this regard, is comparable to

vapor or hot air bath. When the application is repeated many times, the part become pigmented, or browish color, just as when the surface is exposed to the sun's rays.

It is proper to call attention here, to the interesting observations of Conrad Klar respecting the rate at which heat is eliminated from the surface of the body when fully exposed in an atmosphere below the body temperature. He found that the rate, during the first five minutes, was ten times the noraml, or eighteen calories per minute; in the second five minutes the amount of heat eliminated was only twice as great, the diminution being due to the contraction of blood vessels resulting from the contact with cold air. In an electric light bath the radiant heat maintains continuous relaxation of the surface vessels without heating the air about the patient to any appreciable degree, if free circulation is maintained. It is thus possible tomaintain continuously, for a considerable length of time, conditions most favorable for heat elimination, while, at the same time, heat production is being stimulated by the thermic impression made, and the elevation of the temperature of the blood through exposure to the action of the heat rays in the widely distended vessels of the skin. This special characteristic of the electric light bath unquestionably accounts for the increased production of CO_2 which is a proof of the stimulation of the powerful influence of the bath upon metabolism, and accounts for its remarkable alterative and reconstructive effects.

3. General perspiration is produced more quickly by the incandescent electric light bath than by any other known procedure, generally appearing within three to five minutes after the patient enters the bath, and quite regardless of the temperature of the bath . This fact has been noted by Wintermitx and other observers, as well as by the author, by whom the

fact was first pointed out. Winternitz reports having seen perspiration appear within a very short time, and at a temperature not above 85°F; the length of time required to produce perspiration in the Turkish or hot-air bath is generally seven times as long, and the intensity of the cutaneous activity is considerably less.

The quantity of the perspiration is considerably greater in the electric light bath than in any other sweating procedures. That the sweating is caused by the radiant energy from the contact of the hot air with the body is shown by the fact that vigorous perspiration may be produced in a small area of the body, as in an arm or leg, by subjecting the part to the influence of the light rays. (Insert nnte relative to perspiration.)

4. There is a rapid rise in the internal temperature in the electric light bath, and the author has noted and elevation of tempeature amounting to four or five degrees above normal in only fifteen to twenty minutes. This is a fact which was first reported, in a paper read by the author in 1894.*

This part of the bath renders it of special value in the treatment rheumatism, gout, and other phases of the uric acid diathesis.

5. A study of the respiration-products shows a very decided increase in the amount of CO_2 eliminated, an evidence of the very active oxidation set up by this procedure.

In observations made by the author in 1894, the averge per cent of CO_2 eliminated in an electric light bath of thirty minutes was found to be 5.13 per cent in a patient who, previous to the bath, was eliminating

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* The incandescent electric light, or Radiant Heat Bath, read before the American Electrotherapeutic Association at its annual meeting held in New York, Sept. 25-27, 1894.

3.60 per cent. In a Russian bath the same subject eliminated an average of 3.96 per cent, while in a Turkish bath of thirty minutes the average elimination was 4.01 per cent.

6. The blood-count is increased to a marked degree by the electric light bath followed by the usual cold bath; the increase appears within half an hour, and continues for a longer time.

Under the influence of the incandescent electric light bath, the pulse is at first slowed, but later, becomes fuller, and the pulse rate quickens. The blood pressure is at first increased, later, diminished. The author, in observing the blood pressure, noted the following changes: .....

THERAPEUTIC APPLICATIONS. -- The incandescent electric light bath is unquestionably the most exact and convenient of all modes of making either general or local applications of heat of an intense degree. Winternitz, of Vienna, remarks upon this point, "The electric light bath presents an advantage over every other means of supplying heat, in the readiness with which the dosage may be regulated as regards time an intensity."

Rieder, referring to the incandescent electric light bath, in his chapter on "Phototherapy" in Goldscheider's Hand-Buch der Physikalischen Therapie, remarks, "The incandescent electric light bath possesses another great advantage over other sweating baths, in that the temperature and the amount of heat radiation can be quickly and accurately estimated, and that an ample amount of perspiration may be induced, even at a comparatively low temperature, and so quickly that the patient need not remain in the bath more than fifteen or twenty minutes.....Again, the patient enters the bath while it is at a low temperature. This method is, then, far superior to all others.

THERAPEUTIC EFFECTS.-- The therapeutic effects of the incandescent light may be briefly summarized as follows:

1. It is one of the most effective of all means of producing general and local revulsive effects, by a dilatation of the cutaneous vessels The red-dening of the skin begins with in a very few moments after the influence of the light is brought to bear upon the skin, and becomes more and more intense as the application proceeds. The permanency of the effects produced may be greatly increased by a short, cold application following the light bath. The effect such an application is to fix the blood in the skin by converting the passive venus congestion into an active arterial congestion in which the "peripheral heart" is brought into active play.

2. The incandescent electric light bath has no competitor among therapeutic means as a sudorific measure; it induces perspiration more quickly, and more vigorously than any other agent, and at the least inconvenience and discomfort to the patient. When employed for this purpose, especially when the bath is considerably prolonged, great care must be taken to protect the heart and the head by means of local cold compresses, the patient should be made to drink water very copiously, so that there need not be excessive thinning of the blood. Applied in this way, the most powerful alterative and spoliative effects may be induced.

3. The incandescent electric light bath is a most effective means of promoting the absorption of exudates. For this purpose both general and local application are valuable. In France, the general electric light bath has been used successfully in promoting absorption of exudates in the cornea of the eye, and opacities in vitreous and like affections. The writer has used it with most gratifying success in promoting absorption of exudates from the crural and peritoneal cavities and exudation in and about the joints.

There is no known means by which the absorption of exudates in the joints may be more rapidly induced than by general applications of the electric light bath, combined with local applications of the light to the affected parts by suitable hydriatic applications. Care should be taken to administer a cooling bath after general applications, and after local application to the joints, an alternate spray or douche should be applied, this to be followed by a heating compress consisting of a linen towel wrung as dry as possible out of cold water and wrapped about the knee, covered with mackintosh and the whole covered with several layers of dry flannel so as to retain the heat.

The local application of light should be made at least twice daily, the general application once a day. The heating compress should be changed at least twice daily. Massage, and, in some instances electric applications to the parts, and especially the adjacent muscles, are important therapeutic adjuvants.

4. For tonic effects, short applications of the incandescent electric light bath, from three to eight minutes, are incontestably excellent,--the sensation of wellbeing, similar to that experienced by one who stands before a glowing fire, is most pronounced, and, when followed by a proper hydriatic application, the highest degree of tonic effect possible to be obtained by any known therapeutic measure, may be secured. This statement is not made at random, but after having tested this important therapeutic measure in the treatment of many thousands of patients , comprising, in the practice of the writer and his colleagues, more than one hundred thousand applications.

5. The following may be named as pathological conditions in which the incandescent electric light bath has been successfully employed in the treatment of uric acid diathesis in all its forms, including rheumatism,

gout, lithiasis and neurasthenia due to uric acid poisoning. The increase of oxidation, and general promotion of metabolism aids in the burning up of the nitrogenized wastes and other eliminations of these toxic elements from the body. In cases of this sort, the bath should be applied two or three times weekly to the extent of producing vigorous perspiration and elevation of the bodily temperature to the extent of two or three degrees. Copious water drinking, and an anti-uric acid diet and abundant exercise out of doors, must be applied at the same time.

Diabetis and obesity are benefited by the electric light bath through its potent influence upon CO_2 formation through the stimulation of the oxidation processes within the body. Fat diabetics are especially likely to be benefited by the electric light bath. An inactive skin is caused to sweat freely under the powerful stimulus of the light bath. An increased oxidation of carbohydrates lessens the output of sugar, the alkalinity of the blood is increased, and thus the whole organism is better prepared to correct this disorder to which this dietetic malady is due.

Obesity is a disorder of nutrition which is an high degree amenable to this powerful therapeutic means. The electric light bath does not, like most other sweating baths, simply extract a considerable amount of water by increasing the activity of the skin, but, through the penetrating power of the rays of radiant energy, much more is accomplished. The deeper structures of the skin are excited to activity, the heat-making processes by which fat may be consumed, are excited to activity to an unusual degree, as shown by an increased elimination of CO_2, which, in the author's experiment, was found to amount to an increase of more than thirty per cent. When it is recollected that at least three-fourths of the energy of the body is consumed in heat production, it is apparent that an increase of tissue

consumption amounting to much more than thirty per cent, is a matter of the highest importance. Suppose this increase to be continued for the space of one hour only, as the result of the application of the general electric light bath,-- this would represent a considerable consumption of tissue, but as Conrad Klar has shown, the heat elimination may be increased to more than ten times the normal amount, and this may be continued, not for a few minutes only, but for a considerable length of time, when the temperature of the air surrounding the patient is below the temperature of the body, while the blood vessels are maintained in a state of active dilatation, as is possible in the electric light bath-- suppose this condition favorable to increased heat elimination with a commensurate amount of increased heat production, the fuel - consumption to continue for the space of twenty minutes,-- the result may be readily determined by a little computation. The average heat production and heat elimination amounts to 1.8 great calories per minute. Multiplying this by ten we have 18 calories. Again multiplying by 20 we have 360 as the total amount eliminated in an electric light bath continued for twenty minutes under proper conditions. This would represent 80 grams of pure fat, and not less than three times the amount of adipose tissue; it contains a considerable amount of water as well as fat. three hundred and forty (340) grams equals 8 omes or one-half pound, prepresenting the actual destruction of tissue resulting from an electric light bsth of thirty minutes. It is safe to say that there is no other known therapeutic measure capable of accomplishing such a result in so short a space of time. The consumption of an equal amount of tissue would require, for a person weighing 90 gilograms (200 lbs.) to walk many miles. Clinical experience, as well as theoretical experience have proven the electric light to be, of all heating and eliminative procedures the most effective. For the

best results the light bath must be associated with the prolonged cool bath which likewise increases CO_2 production to almost any extent which may be desired, and exercise should be included. The cold baths serve as an antidote to whatever depressing effect may result from prolonged sweating baths and prepare the body for vigorous exercise by energizing the muscles and the heart, and increase the aptitude as well as the capacity for muscular effort.

Sciatica, intercostal neuralgia, vague neuralgic pains, myalgia, and other neuralgic affections, yield readily, in majority of cases to the daily or tri-weekly application of the incandescent electric light bath, especially when associated with carefully administered tonic hydriatic measures, massage proper dietary, and an out-of-door life. Auto-intoxication, as well as chronic metal poisoning, is another morbid condition, which finds in the incandescent electric light bath a most efficient remedy. The enormous elimination of water through the skin secures the ingestion of wate and at the same time promotes absorption through the mucous surface, thereby subjecting the tissues to a varitable water bath, cleansing them of accumulated wastes and other toxic agents which disturb metabolism through its activity and interfere with the natural work of every description.

In chlorosis and anaemia the most excellent results are obtained by the systematic employment of the incandescent light bath; there is no more efficient means by which the contracted cutaneous vessels which characterize these disorders may be dilated, thus relieving the visceral congestion, a condition universally present in these maladies.. This prompt balancing of the circulation establishes the primary condition essential as an aid to the recuperative powers of the body in their effort to re-establish normal bloodmaking processes,and in other nutritive activities.

In nephritis,the electric light bath, by the reversion of half to two-thirds of all the blood in the body,into the skin, affords prompt

relief of the congested and inflamed parts. In this condition perspiration may be prolonged for many hours if necessary, care being taken to refresh the patient at intervals by short, cold rubbing with a friction mit, by an ice-bag over the heart, and protection of the headwith cold compresses. Great care should be taken to avoid chillingthe patient; a very slight chill such as might be found in momentary exposure of the body to the influence of evaporation from a moist surface, might be sufficient to cause contraction n of the cutaneous vessels and counteract the good effects of the bath. After the administration of the bath, thepatient should be at once wrapped in flannels and perspiration should be maintained from twenty-four to thirty-six hours, or until the renal function is established.

According to Rieder the incandescent electric light bath affords good results in syphillis, in chronic bronchitis and bronchial asthma. Rieder also obtained good results from the use of this bath in cardiac hypert-rophy, In fainting heart, and in cardiac dropsy.

In these conditions this bath must be used with a considerable degree of caution, care being taken to avoid an excessively high temperature and to increase the temperature of the bath very gradually. The heart must be gaurded by an ice-bag placed over it before the heat is turned on, and the bath should be for a short duration, barely sufficient to induce gentle perspiration; the cold mitten friction should be applied immediately afterward Great care should be taken that the patient does not become chilled.

The cutaneous activity induced by the procedure with the precauti suggested greatly relieves the burdened heart, both by lessening resistance in the peripheral vessels and by setting at work the "skin-heart" which is often almost inactive in this condition.

The writer has seen excellent results following the use of this

bath in myxoedema, exophthalmic goitre, chronic intestinal catarrh, locomotor ataxia, spinal sclerosis, in all forms of indigestion, in neurasthenia of vaious types, melancholia, hysteria,-- and, in fact every form of chronic malady, with the exception of eczema and some other forms of cutaneous eruptions.

To mention all the therapeutic indications of the incandescent electric light bath, together with the special indications partaining to each particular malady in which it may be advantageously employed, would involve the discussion of almost every important chronic affection known to medical scienc r.

This procedure is certainly the most effective means whereby it is possible to bring into activity an to maintain in operation those natural recuperative forces by means of which all actual curative processes must be instituted and carried forward. The bath itself does not, of course, cure anything; the body cures itself whenever a cure of any sort is accomplished, and, through its influence upon the nerves, the blood and other tissues, the incandescent electric light bath operates most powerfully in aiding the natural recuperative processes of the body.

The tonic value of the electric light bath can scarcely be overestimated. In cities where sunlight is available only to a limited degree at any season of the year, and during the winter when the sun's rays are of little intensity, and are, for the greater part of the time, obscured by clouds, the electric light bath affords a capital substitute for sunlight. The exposure of the naked body to the influence of the intensely active radiant energy thrown off by the incandescent electric light bath during a period of from five to ten minutes daily, or tri-weekly, is a measure certain to afford ample compensation for the trouble and expense involved. Care sh should be taken, however, to follow the bath by a short plungein the swim

ming pool at a temperature of 65 to 75° or a vigorous application of the douche at a temperature of 60° to 50°. The cool half-bath, or even the cold rubbing sheet, are less vigorous but effective substitutes for the douche or the plunge.

The tonic and rejuvenating resulting from such a bath can scarcely be appreciated by one who has never experienced it, but when a person has once enjoyed the luxury and the light of an electric light bath, concluded in the manner described, he will be certain to repeat the experiment as often as opportunity affords.

(A note to be inserted in its proper place.)

TUBERCULOUS JOINTS.-- In cases of limbs, the bones which are affected by tubercular or inflammatory disease, chronic ulcers of the limbs, paralized parts, and parts subject to trophic changes may be benefited by exposure to the full sunlight, by the application of the concentrated rays which afford a peculiarform of vital stimulus differing from any other known, but in a high degree essential to life, the effect, however is a protoplasmic stumulant. The writer has planned and is having constructed an instrument by which filtered and concentrated rays of the sun may be simultaneously applied to a large portion of the body.

(Notes for insertion.)

(Note for "Technique".)

In cases in which patients are rather intolerant of heat, the temperature may be gradually raised by throwing on only a part of the lamps at the beginning of the bath, or bringing into use additional groups, as the patient becomes able to bear a higher temperature.

(Another note for "Perspiration.)

The profuse perspiration used in an incandescent electric light bath is doubtless due, in large part, at least, to the stimulating effects of the light rays upon the nerve endings in the skin.

(Another note for " Physiological Effects".)

Respiration is free, and without embarrassment, and is somewhat quickened, a condition widely in contrast with the distressed breathing so often induced in the Turkish and the Russian baths.

Dr. Kellogg. Sup

TALKS TO JUNIOR MEDICAL STUDENTS. Dec. 13, 1901.

J. H. Kellogg, M. D.

Disease---- Defences of the body.

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Sweat of the skin when it remains on the body long enough to become acid forms one of the defences of the body. Pthogenic, or disease producing germs grow in an alkaline medium, while acids attenuate their virulence by their inhibatory power. This is true that simple orgainic acids as malic acid citric acid , are deadly weapons against the cholera bacillus and the typhoid fever bacillus, so that they are destroyed and their development inhibited by these acids - even by the acid juice of an apple. The dry skin of a fever patient is an unhealthy skin, and is likely to be the seat of eruptions in fevers,-- and is likely to be the seat of other eruptions-- and what are they? ("Bed sores.") Yes-- gangrene and sloughing of the tissues. This is due to the fact that these germs grow upon fever patients,-- they cannot grow upon a healthy person. so these germs get a foothold in the body, and this is due to lessened resistance of the cells which compose the skin. (I see you are not taking notes, and this is a subject which you should not forget.)

Q.-- I don't understand about the chemistry of sweat,-- it is alkaline normally, is it not?

A.-- There are some acids eliminated through the skin; the sweat is about neutral when first eliminated. The more abundant they are the better. If there is anychange in the sweat it is acid. After remaining on the body for some time it becomes acid and sour so that the clothing has a sour smell, from the fermentation taking place, but there is not development of pathogenic germs,--

Q.-- Why is that germs live in the body when a person has rheuma-

tism?

A.-- Because rheumatism lessens the resisting power of the tissues-- I am glad you asked that question. We will spend a moment on this point,-- the acid attenuates the germ and lessens its virulence, while the germ lessens the resistance of the tissues; so the question is as to which is lessened the most-- the virulence of the germ or the resistance of the organism; if the resistance of the organism is lessened more than the virulence of the germ is attenuated the germ, the germ gets the best of it.

Q.-- What acids are eliminated through the sweats?

A.-- Fatty acids,-- lactic acids, etc; the skin is a channel through which these acids are removed from the body. When lactic acid, for instance, is produced to an abnormal degree the perspiration becomes sweet. ..... There is one more defence of the body through the skin which is an exceedingly interesting form of defence,-- that is through the nervous system. Every organ of the body-- every viscus within the body, is separated by a certain reflex area of skin. The real truth of this is clearly shown in a form of disease known as "hysterical anorexia". A person who suffers from this trouble has no appetite. The same thing exitts in some forms of insanity. In some of those cases the patient has an illusions for example, that he has no stomach. The brain is so closely connected with the stomach that when he thinks he has no stomach he has no appetite, and he thinks there is no use of eating. Now this is a case of hysterical anorexia. We examine a patient and find an area overlying the stomach in which there is absolute insensibility,-- Dr. Sapelier made this observation a number of years ago and found that, when pain began in the umbilicus, after the corresponding gastric area was localized complete anesthesia was found; in such cases we shall always find the gastric cutaneous area in this condi-

tion. I learned this of Dr. Sapelier, and I soon afterwards happened to have a case of this kind; upon examination I found absolute anesthesia in the corresponding region overlying the stomach-- the whole gastric cutaneous area of the part was found in this condition. It is interesting to notice that this patient acquired an appetite under proper treatment-- electricity, etc.-- his cutaneous sensibiltiy gradually returned until in time the patient's appetite was restored, the cutaneous sensibiltity was also restored. I have observed the same thing in two or three other cases. Here we see the close connection which exists between the internal organs and the skin.

Now what protedtion is afforded to the body by this connection? Mr. Seton has made some interesting experiments in this direction, by holding up a rabbit by the ears and blowing in its face, on which the rabbit immediatdy became hypnotized. Some hypnotists have adopted this experiment not by lifting their subjects up by the ears, but by blowing in their faces to attract their attention; either this, or something else is done to make a strong empression upon the subject.

Let us see what benefit is derived from this intimate relationship between the skin and the visceral organs. We know for example, that if we apply cold over the stomach, chest, spinal column, or any other portion of the body there is an immediate impression made upon the viscus which is immediately related to that surface,-- the blood vessels contract-- does anything else happen besides this contraction of the blood vessels? Every thing else happens that can happen. Why do the blood vessels contract? ("It is due to the nervous effect.") Thw vasomotor nerves are stimulated. If this were constantly practiced,would the secretory nerves be stimulated? ("Yes.") Yes,--and also the trophic nerves; every nerve entering the parts is stimulated. We can immediately see the influence of this stimulated

activity of the trophic nerves. The influence upon the secretory nerves would be shown by the increased secretion. Is there any other evidence of increased secretion in the stomach? ("Increased HCl.") The "hypo" might be lifted to a normal standard by the application of cold over the stomach. The cold contracts the bloodvessels by stimulating the vasomotor nerves, and, at the same time, the secreting nerves are stimulated, and the vasomotor nerves are again stimulated and all the activities of the skin are excited by this application of cold.

Now, in the application of heat, and applications of lessened cold, we have a withdrawal of this effect. Suppose we put a man in a warm bath at 92^{o} to 95^{o}--what change takes place in him under those circumstances? Of course we cut off all external stimulation which keep the nervous system stirred up. These are all the time acting upon the nervous system, and, under ordinary circumstances, we do not realize any unpleasant effects at work; but at length the nervous system gets into such a state of sensitiveness that these stimuli will keep him awake; then we may, in part, relieve him of this external stimuli.. If a man has a burn, he experiences intense pain in the injured part when exposed to the air; the nerves are unprotected, and they are abnormally sensitive; but when covered with a poultice by being put in water at a temperature of 92^{o} to 95^{o}, the pain disappears at once. So you see that by the application of a neutral bath we are not making a positive application but a negative application; we are not supplying somethigg,--we are subtracting something; we are simply withdrawing external stimuli,or antidoting it, for the maintenance of life. The light, the consyant changes of temperature, the play upon the blood by electricity,etc., are all put in operation upon the skin; so the skin is a sort of key-board upon which external stimuli can play, to maintain the internal activities of the body.

The skin is also a protector of the body against electricity. It

is a non-conductor. It has greater resistance than the visceral organs--and how much? ("Two hundred times as great.") You will have to add a couple of ciphers to that number,--the resistance of the skin is twenty-thousand times as great as that of the internal organs. Under ordinary circumstances, we do not know anything about atmospheric changes, or electric changes, but if our organisms, from any cause, become abnormally sensitive, then, whenever there is a storm coming on, we get notice of it by twinges of the sensitive nerves, or by aching, sensitive joints . Did you ever hear of one who could tell when a storm was coming on by these nervous sensations? ("Yes.") The skin is a protector against those influences, when in health. It is also a protector against electrical discharges which we might find to be very uncomfortable while traveling in cold weather, for even slight discharges of electricity might become sensible. Did you ever try the experiment of taking hold of the copper wires of a dynamo when in operation and grinding ou a thousand amperes--you can take hold of copper wires as big as your thumb when the dynamo is in operation, and you can do so without injury. This is because of the resistance of the skin. But this resistance is lessened if your hands are thoroughly moistened with soda; but if your hands are perfectly dry, you can take hold of the prime conductors with safety. This would not be true of the wires of an arc-light, because the voltage ~~of that~~ is less than of the arc-light; a voltage of 110 is not sufficient to produce injury.

Let us notice some of the defences of other organs,--for instance that afforded by the nose. In the nose, we have a strainer which strains out germs, and this is done so perfectly that the unexpired air is absolutely free from germs, except in sneezing, coughing, or speaking forcibly; and there are some particles of moisture expelled in this manner which are found to contain germs when coming through teeth which are somewhat infected with them. So it is well, in the operating-room, to have the mouth covered,

because, in making dental sounds, as, in making the sounds of "t," "d," "th,", etc., one is forcing breath through the teeth, some portion of which is thrown off through the teeth in the form of spray, and may contain microbes; but unexpired breath is free from germs, as they are filtered out by the mucous membrane of the nose, and the hairs ,and the ciliated epithelium in the deeper respiratory passages; the mucus and the mucous membrane of the nose are intolerant of germs, preventing their development. Even the bacteria of Chardon, which is a very powerful germ, the virulence of which is attenuated when applied to the nose. The bacillus coli communis is also destroyed when placed upon the mucous membrane of the nose .

It is interesting to note that many germs produce a substance which destroy them,--just as the body produces substances which destroy living tissues . The glands of the nose produce a substance which is deadly to germs,and which is not deadly to human tissues. Mucin is a toxin which is produced by a certain germ, and which is destructive to germs. Now the mucous membrane of the nose produces the very germ that produces that toxin. Here you see again a wonderful intelligence manifested in the care of the body. The mucus of the mouth has the same property. The saliva has also been proven to have bactericide properties. Germs form mucin in the presence of animal matter. Germs which grow in the nose and become domiciled there, form from the serum, a poison that destroys them and protects us against them,--and what is true of the mucus formed in the nose is true of mucus formed elsewhere .

I ought to say something of the tonsils, as they protect the body to some extent; they produce an internal secretion which is thrown into the blood, and which unquestionably have something to do with the protection of the body.

The stomach also defends the body, and it does so through the influence of the

influence of the gastric juice; the gastric juice is a germicide. The mucus formed in the stomach is a germ-inhibiting substance. Mucin is present in the mucus and the mucus attenuates the virulence of the germs, and so renders the stomach inhospitable to germs. We know that the mouth, colon and small intestines are more liable to be diseased than is the stomach; the stomach is tough, and does not very easily become inflamed, as do some other portions of the body; the eye, for instance, becomes easily inflamed, but the same thing that causes inflammation of the eye will not cause inflammation in the stomach. It would be impossible for a person to put into his eye such things as mustard, pepper, pepper-sauce, etc., without inflammation, but, when introduced into the stomach, alimentary canal, and other parts of the body, no perceptible harm is experienced, because the mucous membrane is coated with a mucus which protects it. Not only so, but the mucous membrane of the stomach resists poisons. It is constantly assailed by poisons which are continually being taken into the stomach. But these poisons are not readily absorbed in the stomach to any very great extent,--is there anything absorbed in the stomach to any considerable extent ? ("No.") Is water absorbed extensively in the stomach? ("No.") We know that it is not; so we know that absorption is not a property of the stomach. What cavity of the stomach is given to absorption? ("The small intestines.") Yes, but particularly the colon. The small intestines have a digestive property. The property of the stomach is to bring substances in solution, but not to absorb them, while the property of the colon is to absorb them. The mucous membrane has both properties combined--it is both a digesting and an absorbing organ .

We see, then, that this resistance on the part of the mucous membrane of the stomach is an advantage, because the poisons, instead of being rapidly absorbed in the stomach, are slowly absorbed elsewhere, so that they

are eliminated as rapidly as they are absorbed. Suppose you have a finger poisoned,--you place a band or ligature around it for a few minutes, and then loosen it, and then tighten it again, so that the poison can be eliminated as as rapidly as it is absorbed,--for instance in case of a rattlesnake bite, you put on a ligature at once, and in about five minutes you loosen it,and then tighten it again, and the poison is slowly absorbed and eliminated.
So we see that the stomach protects the body by destroying poisons through the activity of the hydrochloric acid,which is a germicide,--and we may add that the pepsin of the stomach, by the help of the hydrochloric acid, acts in the same way, by the digesting of certain germ-cells,--good strong pepsin with hydrochloric acid to help it, can digest germ-cells; it can digest vegetables, as, as mushroom, or a cabbage, and a germ is a vegetable, so it can digest germs, as well as parasites of various sorts,--when taken into the stomach, they are digested and destroyed by this means, and in that way the stomach defends the body against against these invaders. There are always present in the stomach toxic substances, and the gastric juice is toxic. Hydrochloric acid, which is formed in the stomach, when separated from the pepsin, is found to be toxic in proportion of .4 of one per cent.; it is found to be toxic when in a physiological solution, it is injected into the veins of dogs. A pepsin solution in proportion of .9 of one per cent.will kill other animals as well as dogs , when injected with it,--the dog dies with coma when injected with this solution, so we know that the gastric juice is poisonous. The peptone formed by the gastric juice is poisonous also, and when injected into an animal, it shows decided indications of poisoning, and dies of convulsions.

So the stomach is all the time producing poisons, and the mucous membrane of the stomach is always protecting the body against these substances by failing to absorb them. The stomach manufactures substances which

are toxic, but refuses to absorb them; it would not be safe for the stomach to absorb them, so they pass down further, into the intestines where they are slowly absorbed. The mucus also protects the mucous membrane against the digestive action of the hydrochloric acid itself.

Now, in reference to the pancreas: They have three important ferments,---starch-digesting, or amylotic ferment, fat-emulsifying, and peptone-forming; in addition to that, they have an internal secretion forming ferment, so they have four ferments. What does this internal ferment do? ("It works on the glycogen and helps it digest.") This internal ferment furnishes the liver with material by which it is able to do what? ("Convert insoluble substances into soluble, to be carried off in the circulation.") It does more than that: It furnishes the nervous system with a certain stimulus by which the pancreas formation of sugar is controlled by the liver. So both the nervous system and the liver are notified,--and that is the only way by which the pancreas communicate with the nervous system and the liver--that is, through this ferment which circulates through the blood.

The pancreatic juice, like all the other digestive fluids,--like the saliva, the tears, the sweat,, and the bile, is more or less germicidal in character; it has very distinct bactericidal properties.

Now, in reference to the liver: We find that the liver is one of the most interesting of all the organs of the body; let us notice the way in which it defends the body: In the first place, the liver has something to do with the blood--and what is that? ("We haven't had this study.") What does it do? ("Manufactures red blood corpuscles.") Instead of magnifying blood-cells, it forms soluble substances necessary for the blood; it manufactures these substances which are thrown into the blood, and which act as regulators of nutrition. It is supposed that the liver is the organ which manufactures the oxydases which we have been talking about--or at least some of them--by which the processes of metabolism are regulated in the dif-

ferent tissues. The liver is supposed to furnish certain elements necessary for the support of these oxydases, and that it stores up a considerable amount of iron; the amount of iron stored up in the liver is found to be greater than in any other part of the body, and it is supposed that when it disposes of and cleans out the blood-corpuscles,and gathers up the remains of these corpuscles which have been left behind by the spleen, it saves the iron and gathers up the coloring matter, thus making an abnormal pigment material in the body while saving the elements necessary for the oxydases.

The liver also does an important thing by capturing the sugar that would otherwise enter the blood,--but, according to Pavy (not understood) This change must be completed perfectly, or else some portion will slip thro' the liver into the blood, and thus we will have alimentary (?) diabetes resulting from intestinal indigestion, as has been clearly proven by Pavy. In its normal condition,the liver stores up glycogen and converts it into sugar, and then deals it out to the body as required. In this way the liver becomes a marvelous regulator of nutrition. The hepatic cells supply all the glycogen required by the muscles.

Now how large a portion of the body is supplied with heat by the combustion of glycogen,--or rather, I will say, How large an amount of glycogen is consumed in the production of heat,under ordinary circumstances. Suppose a person is at rest,--perhaps you have not learned this--the amount consumed is about 91 % ; when a person is at work, about 74% is consumed,--in other words, when one is at work, 74% is converted into heat, and when one is at rest, about 90 per cent. is converted. So, when a person is at work, one-fourth of the glycogen goes into work, and three-fourths into heat, and when one is idle,, nine-tenths is consumed in heat,and one-tenth in work (?). So when a man is idle, this is deposited as fat--as reserve

But suppose this is nitrogen--

tissue laid aside to be used when needed by the body. This fat seems to be converted back into glycogen, and the only way by which it can be burned is by being converted into glycogen, because the ferments in the muscles where the oxydases are produced, are arranged for action upon the glycogen, so the fat must be converted into glycogen. Recent observations make it clear that the liver has power to store up fat. For many years it was known that the blood which leabes the liver has less fat in it than the blood which comes to the liver,--and what is done with it? The suppositio was that it was transformed into something else,but a far more reasonable supposition is, that the liver changes fat into glycogen and holds it back, the same as the products of starch digestion in the stomach. This is interesting, because it shows how starch and fat can be made to replace themselves in dietary; that when a person takes less starch, and more fat, it can be treated by the liver in the same way as starch, but with less ease. The fat is held back in the liver,--how do we know that? Claude-Bernard has shown that when an animal has been fed a large amount of fat, it is found that the liver of such animals holds back the fat until it can be converted into glycogen, which seems to be a slow process, the fat requiring oxidation and hydration. ("Some of it goes the other way?") Yes; a part of it goes into the portal vein along with the other food, and that which goes into the general circulation goes back to the liver again, and is distributed through the body; but the liver holds back the fat, as Claude Bernard has shown,--and some fat remains in the liver--("You will have fat emboli?") Yes; such persons will be subject to boils, because of the lessened resistance which always accompanies such a condition. We also have small hemorrhages and stases, the formation of a clot, and infection, suppurations and abscesses..

The liver does something more,--it is a destroyer of poisons; one of its most important functions is the oxidation of poisons. But if a per-

son's liver becomes triturated with poisons, as nicotine, it loses its power to reduce toxicity to a noticeable degree. If we inject poison into the portal vein of a dog or a rabbit, and then into the hepatic vein of another dog or rabbit, it is found that it requires twice as large a dose to kill the animal, when injected into the ~~portal~~ hepatic vein, as when injected into the ~~hepatic~~ portal vein. the liver being healthy, showing that the liver, when in a normal condition, reduces toxicity one-half. The liver is continually destroying the poisons taken into the body. These toxic substances, taken to the liver through the portal vein are destroyed in the liver, also various toxic substances formed by indigestion, as the result of fermentation of foods in the stomach; ammoniacal and other substances are oxidized,--and then what becomes of them? ("They are converted into urea.") And the urea has but little toxicity; it requires a large dose of urea to destroy animal life, but it requires but a very small dose of creatin, creatinin, uric acid and various other toxins which are supposed to be the antecedents of urea.. In the liver, oxidation takes place by means of which ammoniacal compounds, and other poisons are separated into comparably ~~small~~ non-toxic substances, and thus the body is protected by the liver.

There are other things which the liver does besides the destruction of worn out materials, as corpuscles, etc.; it is also a barrier against metallic poisons, which it stores in itself, for the liver not only stores up glycogen, but also lead, arsenic, and iron. If you give your patient iron, to any considerable quantity, it will store that up; it stores up all metallic poisons, alcohol, etc., the liver thus sacrificing itself for the good of the body.

Q. How do parasites of cancer get into the stomach?

A. It is only when the stomach is deteriorated that cancer parasites can become fixed and injurious there; it is unquestionably true that the stom-

ach becomes deteriorated by the by the long presence of toxic substances contained in foods,--lactic acid, butyric acid and other acids; they lessen the vitality of the tissues, and gradually lower the standard of tissue formation in the stomach, so that by-and-by the glands degenerate, and cease to produce the proper amount of hydrochloric acid and pepsin, and then the nerves become disordered so they do not make proper reports of things, and refuse to call for food, when food is needed; they lose their sensibility, the muscular walls become attenuated, and the st omach is weakened and becomes the hold of every unclean and hateful thing, and is thus in an abnormal state, when these parasites are brought in, and obtain a foothold. The colon bacillus lives in the colon and in the blood serum. It is always producing toxic substances. A large part of the work of the liver is the removal of the toxins which are formed by the colon bacillus; this germ is the only one which seems to be at home in the human body. But it is not found in the alimentary canal of the new-born child,--the new-born babe is absolutely aseptic; there is no germ found in it , and if it can be placed in perfectly aseptic conditions (such as I believe once existed), there would not be a germ in the human body,--and if there were no germs, I believe there would be no death, except by accident. Because it is the action of these toxic substances which are absorbed, and which modify the metabolic processes of the body,that lead to degeneration. It has been shown that the poisons formed by the colon bacillus, when carried into the liver,result, after a while, in setting up sclerosis of the liver and spleen, and the same thing must happen to the vessels of other parts , sooner or later. The liver receives the poisons first, so it receives , so to speak, the brunt of the attack, and then the spleen receives it; and after a while, when thes organs become saturated with these poisons, the result is premature old age. An Italian investigator once said he had discovered the germ of old age,and I believe it is germs that cause old age. I believe there was a time when no

germs existed in the alimentary canal, and that that is the reason that Methusaleh and others lived so long; it was because their bodies were able to hold all manner of germs at bay. Their bodies were perfectly healthy, so that poisons, if received into the body, were not absorbed. But , as the result of wrong habits and diet, and consequent degeneration of the body, our systems are permeable by germs, and so the alimentary canal and other parts of the body have become the habitat and resort of all sorts of deadly germs.