LECTURE TO MEDICAL STUDENTS, Jan. 5, 1903.

THERMOHERAPY.

J.H. Kellogg, M.D.

One pound of water will evaporate from the skin by free perspiration, in an hour. Evaporation will be much more rapid from the surface which radiates and absorbs rapidly. A surface which will absorb rapidly will evaporate rapidly. Water evaporates more rapidly from a rough surface than from a smooth surface, hence it will evaporate more slowly in a new kettle than in an old one. When a kettle gets rusty and rough on the inside, the water boils away rapidly. If you want the water in a flask to boil away rapidly, first drop some little bits of iron or glass into the bottom of it. This facilitates the boiling of the water, because the water is thrown off more rapidly from a rough surface than from a smooth one. So we may reasonably suppose that a pound of water will evaporate from the skin in an hour—about many—how many heat-units would that be? (About 1150?). The body makes (Blackboard calculation) about 432 heat-units. So if the body naturally produces only about 432 heat-units in an hour and loses 1150 heat-units in an hour (approximately three times as much as it makes) this would indicate that heat-production should be increased two or three times, in order that the heat of the body may be maintained. Now the very things that produce heat elimination stimulate heat production,—these two things go together.

Q. Is not heat-production the primary step, and heat-elimination a secondary step?

A. Heat-production comes first; the body-temperature rises and the sympathetic centers are excited and stimulated so that heat-elimination will be increased—but heat-production comes first: the temper-
ature of the blood is raised—heat production takes place when the temperature of the blood is raised. There is first a fluxion effect upon the skin which produces collateral anemia of the muscles, and that lessens heat-production, for it drives the blood from the skin—driving the blood from the skin lessens heat-production. So increased heat-production only takes place after the temperature of the blood is raised.

Q. Will not a rise of temperature come before sweating?
A. Yes,—but there are several other things which come before sweating. There is a temporary effect produced by the influence of heat upon the temperature-sense—that is the transition formed by the reflex effect.

Q. Is not heat-production increased by—— (not understood.)
A. There will be radiation from the body, even though the air is hotter than the body-temperature, it will still eliminate, and there will be an effort at heat-production. Suppose a person is exposed to radiation from a hot fire on a cold winter's night. At first his body would be radiating heat more rapidly than it was received. The heat would be communicated to his body from the fire, and it would be communicated more rapidly than it is radiated, the heat being also accumulated in his clothing, so that the heat would become so intense as to make him perspire.

One of the effects of heat is to increase the oxygenation of nitrogen, and so, stimulate metabolism,—but this effect only occurs when the metabolism of the body is increased (?) You must get this clear in your mind. Suppose you have a patient who is thin and emaciated, and you give him fomentations and cause him to perspire every day. By-and-by he says to you, "Doctor, I don't see why I can't gain in flesh; I am losing in weight all the time." He also has pain,—iy may be
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pain in the side, or a pain in the back, or a pain in the stomach, and the patient complains so much that you yield to his importunities and apply fomentations to relieve the pain; the patient likes the fomentation because it relieves the pain, but every time the fomentation is applied it makes him sweat. But there is an elevation of the temperature of the blood which has produced the sweating, and the patient's metabolism is increased—the metabolism of nitrogen and oxygen is increased, so the patient has been unable to store up energy (which consists of the energy in the granules of the cells). This store of energy in the cells is being eliminated, and the energy which has been stimulated has elevated the temperature of the blood, and this has resulted in increasing the nuclein oxidation. So the vitality of the patient is being lowered all the time, and the strength of the patient is being wasted.

Attention has been called to this fact by Professor Hall, of Owens College, Manchester. Dr. Hall is our man, because he is working out results which we wish him to get; also, Dr. Haig, because he gets the results that we want him to get—I stand by Dr. Haig. We want him to get results which conform to truth. When we get hold of a certain truth, and there is another man who is working in the same direction, he is a brother, and his contributions are in support of the truth, and what he is doing helps build up the truth. But when a man is working in the opposite direction—for instance, trying to prove that alcohol is a food—I don't take any stock in him, because I know that what he is trying to prove is not true, because it is against nature, and against the order of nature. The order of nature is, that plants shall store up energy from the sun, and build up the complex molecules from which we can extract energy from the laboratory of our bodies.
What is Dr. Atwater trying to prove? He is trying to prove that yeast, which is a fungus and a parasite, and lives upon decaying organisms which lives upon vegetable and organic substances, just as man himself does—he is trying to prove that yeast is a producer of food. But that is wrong: yeast is a consumer of food, and it is just as reasonable for him to undertake to show that an animal is a producer of food as to try to prove that yeast is a producer of food. Vegetables are producers of food. There are, however, certain forms of vegetables which are not producers of food, as fungi, which live upon foods just as animals do—just as bacteria and parasitic organisms do—they live upon foods and are not producers of food. Now Dr. Atwater is trying to prove something that is opposite to the whole order of nature—but it is impossible to do that; it is impossible to prove that an animal can be a producer of food. An animal is a consumer of food. So I know that what Dr. Atwater is trying to prove is not true, and I should know that, even if Dr. Atwater should seem to prove by experiment that alcohol is a food, because that theory is opposed to the order of nature—you might as well try to prove to me that light is dark, or to try to prove that gravitation acts away from the earth, instead of acting toward the center of the earth, because it is a universal law that gravitation shall act toward the center of the earth, and it is just as universal and unalterable and solid a law as that of gravitation, that animals are consumers of food.

Dr. Hall has pointed out this wonderful and interesting fact—and that is, that uric acid excreted from the body is the measure of the protoplasmic activity of the body—that is, it is the real measure of the activity of the body; it is a measure of the work done by the nuclei of the cells of the body. The action of the nuclei upon the cells, is
accompanies by the oxidation or splitting up of the nucleins, and uric acid is one of the products of the activity of the nucleins—it is a partially oxidized nuclein—but you have all learned about this. Dr. Hall has called attention to this extremely important and interesting biological fact—that uric acid is the measure of the protoplasmic action of the nucleins of the body.

Q. When a man uses his muscles, how does it affect the brain?

A. When a man uses his muscles in physical work, he also uses the nerve-cells of the brain as much as does a man who is simply thinking, but he uses different portions of the brain... The activity of the nerve-cells is so wrapped up with the activity of the muscle-cells that I don't see how you can separate them; the motor mechanism involves the nerve-centers and nerve-fibers.

Q. Could not a person lie in bed and study, and not exercise his muscles?

A. There have been experiments made upon this point. As to the amount of oxidation taking place in mental and muscular work, it has been found that the man who is working the brain as hard as he can and sitting perfectly still, or "loafing," produces as much waste material or CO₂ as does the man who is working very hard...

Q. Could this not be proved by comparison of farmers with bookkeepers who do not have much metabolic activity?

A. At any rate, oxidation is not complete.

Q. Are not school-children the hungriest creatures in the world?

A. That depends upon how much food and what kind of food they have in their dinner-pails, and how they have to go. I hardly think that mental workers have as good appetites as muscle-workers. That is the reason the lumberman in the North woods can eat fourteen pounds a
day,—he exercises his muscles vigorously. The sedentary man could not do that.

Q. Is not the urea a measure of the center (?) of activity—

A. No. The urea is a measure of proteid oxidation,—ordinary proteids,—while uric acid is a measure of the activity of the cell. The amount of urea depends very largely upon the amount of proteids which one takes in; the amount of urea fluctuates up and down with the amount of proteid food taken. The proteids are used for heat-production...
The old idea that some foods are for burning and others are not, cannot be maintained,—this is looked upon as a classification which cannot be sustained. Albumen produces about the same amount of heat as starch. The product of the oxidation of starch is CO₂ and water.

Q. In wasting diseases should there not be an increase of oxidation,—for instance in diabetes? There is a large amount of urea in the urine.

A. Yes. The alkalinity of the blood is diminished, and the tendency to rheumatism is very great in diabetes. This is the reason why eating meat is bad in such cases. The urea varies with the albumen of the food; I have seen that in many cases,—for instance, some time ago there was a poor man under my observation who had been kept exclusively on a meat diet, and the urea increased in five or six days from 24 grams to 96 grams. The amount of urea is also dependent upon the rate at which the body is broken down. In a fever, urea is always greatly increased,—the body itself is being consumed; and nitrogen and albumen are being used, as well as fat.—I must say here, that in those days, uric acid was not so accurately measured as they are now; the methods of estimation of uric acid, in those times were not so accurate as they are now. There was a large amount of uric acid precipitate,—
it was crystalized as uric acid, and then weighed. That was the only method we had then, but the variation was not so great as to be regarded then. Professor Vaughan told me that there was no method of that kind that was reliable. We didn't know the significance of uric acid then.

Q. When a patient has had a long run of fever, and the condition seems to call for heating treatment, should there not be some arrangements made for the supply of the albuminous portions, or a nitrogenous supply for the body?

A. Yes; but the difficulty is that the patient has but little hydrochloric acid, and but little or no pepsin. The cold bath has the effect to increase the patient's hydrochloric acid, and the production of pepsin, so it is not necessary to make arrangements for a supply--" I am glad you brought this question up, because it is a very practical one. The patient should not be entirely deprived of albumen, which we have in gluten, which is the most easily digestible form. Vegetable albumens are more easily digestible than the animal albumens. Gluten is naturally produced in grain in minute particles running all through it. In this form it is much more easily digestible than in meat. In meat, the albumen is bound together by fibers, and is difficult of access by the digestive fluids; but in well prepared, well dextrinized gluten--for instance we have the albumen in a soluble state, which is easily acted upon by the digestive fluid. The patient could also take the cold bath, and he should be given some good stimulant, as bean broth, and the juices of plants, especially legumes, which have the effect to stimulate the production of hydrochloric acid. A very excellent thing for a feeble patient would be these vegetable broths. Now let us go back to our subject.
Dr. Hall has made this interesting observation, that uric acid is the measure of nuclein activity. Now the material which the nucleus uses for the production of energy is stored up in the cell itself in this form of proteid,—which is called what? ("Nuclein.") Yes. Now if the patient is treated in such a way as to increase this nuclear activity, he will stimulate the nuclein of his body in excess, and in doing so, he will lessen his store of energy. Now how is the energy of the body stored up—in what concrete form? ("It is in glycogen—some of it.") In what other form? ("In fat and heat.") In what other form? ("Albumen.") Any other form? (Nuclein?) We may look at it carefully and see. There are several forms. Glycogen is one form in which store up energy. The interesting thing about glycogen is that it is not oxidizable. In order that it shall become oxidizable, it must first be transformed, or changed—it is interesting to notice that the substances which enter the body. They undergo two kinds of changes. They undergo one kind of change under the influence of the ferments, and they undergo another change which is under the action of the nuclei of the cells. I want you all to get this point, because it is a universal law in the body, that substances which enter the body in the form of nutriment undergo two kinds of transformations,—one of these is due to the influence of ferments, and the other is due to the direct action of the cells. Now what do ferments do? They hydrate. What do cells do? They dehydrate. Failing has worked this out, and it is an interesting fact—it is a general law, running right straight through it. Here, for instance is starch. Now starch, under the influence of the diastase of the saliva, is hydrated and soaked out. Now let us see what happens to starch. When converted into glycogen what is the formula? \((C_6H_{12}O_6)\). What is that? It is glucose or levulose,—it may be either dextrose or levulose, but it is glucose. By the way, there has been
but there is no glycogen found in the blood,—it must again be hydrated and changed into sugar; so it has to pass out of the muscles?

A: I will take up each of these questions separately. I think nearly all physiologists say that, but Pavy has proven that it is not true. He took scrapings from the intestines of a dog and dried them, and he found that they were more active when they were dried and partially decomposed than when they were fresh, and that they have this power of transforming sugar,—it shows that this digestive action which converts maltose into glucose is due to a ferment in the liver. A number of French investigators have been actually able to precipitate with alcohol and otherwise separate the ferment which does this work. We find that there are three kinds of this ferment,—one of which converts maltose into glucose, and which is called "maltase;" another converts lactose into milk-sugar (?) and which is called "lactase;" and still another which converts cane sugar into malt-sugar (?) and is called "sucrase." Sucrase, maltase and lactase all have the same chemical composition,—cane sugar, milk sugar and malt sugar all have the same chemical composition,—and this is the formula for it C\textsubscript{12}H\textsubscript{23}O\textsubscript{11}H\textsubscript{2}O. These ferments, "sucrase" for example, add a molecule of water; then divide by 2 and get glucose. In the case of cane sugar, by the addition of two molecules of water, we have one formula of dextrose, and the other, levulose. In the case of malt sugar there are two molecules added, and we have dextrose. And in the case of glucose, after the addition of another molecule of water, it is split into dextrose. These are effects which have not been recognized by some, because hydrotherapy and nutrition are so closely intertwined that it is impossible to separate them. When we apply water, it is for the purpose of influencing metabolism as well as the circulation of the blood.
Now let us see what we were getting at: All of these processes of nutrition involve these two things, hydration and dehydration. Hydration takes place under the action of the ferments, and dehydration takes place under the action of the cells. Pavy has shown that starch is first hydrated so that it will become soluble and diffusible, and can readily be absorbed, and then it is taken to the liver and dehydrate by the liver-cells into glycogen, -- and why? So that it will not be poured into the blood so rapidly. Suppose half a pound of starch should be converted and into sugar and poured into the blood all at once--into ten pounds of blood--the blood naturally contains one part of sugar in a thousand, and if we put half a pound of sugar into ten pounds of sugar all at once, what would be the proportion? ("One in twenty.") Yes,--five per cent.--Now I will take up the other question and try and answer my other assailant. What does Foster say? He says that the liver enzyme (2) is converted into sugar again---let us see: Here is a rabbit,--a rabbit always has his stomach full of food,--and he has a long alimentary canal--and this is equally true of all herbivorous animals which take a large quantity of vegetable food--and it is also equally true of human beings--and it is equally true of human beings who eat four or five times a day, eating a hearty supper just before going to bed, and there is no time when there is not a large amount of starch in the alimentary canal which is being converted into sugar and absorbed. So that the portal blood of the rabbit always contains five times as much sugar as the hepatic blood. (Illustrating by diagram.) Here is the liver. This is the portal vein, and here is the hepatic vein. This blood contains five parts of sugar to the thousand, and this blood contains one part to the thousand. Now if the portal vein contains five times as much sugar as the hepatic vein, all the time,—every hour in the twenty-four, every day of the week, and every week of the
month, and all the time, what would you conclude from that? ("That that theory was a mistake.") We must conclude that the liver converts sugar into something else—and what is that? ("Fats.") Favy has shown that a molecule of starch is incorporated into the proteid molecule—that is the way peptone is formed into proteid—by the addition of this starch molecule. Pasteur gave proof of that: He put into a tube a pure chemical solution that had no proteids in it at all—he put in some sugar and some potash, and the various salts to be found in the proteid molecule without the albumen. Into this he put in sugar and some yeast-cells, and these yeast-cells were able to multiply themselves; they were able to increase to a prodigious quantity,—in other words, they made proteids, and they made them out of the elements that are found right here (referring to formula ?). It was evident that they were compelled to make these proteids out of sugar. They included nitrogen, but they were compelled to utilize the sugar molecule in building up the proteids.

Another interesting fact is, that in the process of digestion, in the dehydration of albumen by which it is converted into peptone, sugar is liberated,—and you can prove that. It is a peculiar kind of sugar; it is a sugar that does not precipitate with oxide of copper, but it does enter into chemical combinations. There are many sugars which do not precipitate oxide of copper,—cane sugar will not do that,—that is a very common fact. Here is another sugar which will not precipitate the oxide of copper, and can be discovered by other means,—and it has been shown that sugar is formed when peptone is formed,—in other words that albumen is a glycogenic, the glucose molecule being taken out of the proteid molecule—and that is what makes the thing that makes a peptone of it. So it seems conclusive that the liver stores up these various forms of glucose.
forms of glucose in the form of glycogen, and converts this glycogen into proteids; it takes a peptone and converts it into combinations with the glycogen, into proteids, and a considerable amount of it is also converted into fats; this is done by the liver-cells.

Let us see what is the outcome of this. Here is a case of diabetes,—what is the reason the man has diabetes? His liver has lost its power to store up sugar—to stop it—so it slips right into the circulation. There are three ways in which sugar is disposed of: In the first place, the villi have power to stop the sugar, to some extent. It is the duty of the villi to absorb sugar and take it up and carry it to the portal blood-vein so it can be carried to the liver, and thus it can be prevented from entering the general circulation. It takes a large quantity of sugar, but some of it gets into the lacteals, and so it gets directly into the circulation, resulting in elementary glycosuria.

So if a person takes 200 grams of glucose, and it appears in the urine, it is a test of the absorbing power of the villi. Suppose that in the intestinal canal a number of the villi are lost, they become disabled, that person would be the subject of alimentary glycosuria,—and that is very likely to be the case in a case of intestinal catarrh,—and it is easily produced.

Professor Von Noorden has shown that when sugar is taken in large quantity, the villi cannot absorb it all, but it slips on through the lacteals and gets into the blood in that way.

Q. If there is too much blood that reaches the liver, there is portal congestion?

A. It seems that portal congestion interferes with absorption; there is a dilated state of the mesenteric vessels, and there is congestion there, in the diabetic. He almost always has dry, hard skin, and the vessels of the skin are contracted, and necessarily there is a
congestion in the interior. So you can see why we use hydrotherapy in these cases,—to dilate the portal vessels and relieve the congestion, and that will allow absorption to take place. A congested vessel cannot absorb very well, because the blood pressure is very high, and the fluids cannot get in because the blood-vessels are already distended with blood and interfere with absorption. So, when the irritated vessels blood-vessels are congested, they are not in a good state for absorption and that is the case in diabetes. The old diabetic is sallow and tawny because of the congested condition of the blood-vessels.

Q. (Not understood.)

A. First the villi which absorb the sugar and carry it to the liver. Now if these are crippled or if the amount of sugar taken is great—and each individual has his capacity—one individual might be able to absorb 200 grams, and another only 150—when you get beyond the individual's capacity, some of it is taken up by the lacteals. Suppose that on the average, 200 grams can be taken at once,—now if the villi become crippled for any cause, for instance, by catarrh of the intestines from eating too fast and eating coarse food, so that there is a lot of coarse rubbish going into the intestines, and creating an irritation of the intestines, the absorptive power would be diminished, and so less sugar would get into the blood-vessels. This is one barricade against the absorption of sugar. Now the proteid molecule throws this off as a fat—as a cleavage. The proteid molecule has power to throw off the sugar molecule. Cleavage may take place, either as a fat or as a sugar molecule; all that is necessary to make sugar out of fat, is to add more oxygen,—adding sufficient oxygen in the right proportion.. The proteid molecule is so complex, and contains so many atoms, that cleavage can take place in a variety of ways.
Now let us see what happens in these cases: Here is a case of diabetes. He has sugar in his urine, no matter how much you guard his diet. I have had such cases many times, and it seemed as though diet had no influence upon such cases, and when the patient took absolutely no food, he was still producing sugar in large quantities. Fasting will control diabetes if anything will. Regulation of diet will control the disease to a certain extent. If you take all food away from the patient, that would secure most control of the disease, but even then, sugar is produced. Where does the sugar come from? The cells make sugar. What is the origin of fatty degeneration? The same thing, simply an abnormal tendency on the part of the proteid molecule producing a cleavage of the fat molecule (?) which is deposited in the cells and about the cells until a large portion of fat has accumulated. This accounts for the fatty degeneration, and also for the saccharine degeneration which we have in bad cases of diabetes.

But how do we know that the liver does not produce sugar. The ordinary experiment is to throw the liver into boiling water, and then make the test for sugar. I have experimented upon rabbits giving them plenty of cabbages, and had a pinkish liver with quantity of glycogen and a sugar reaction. Drop a little diastase into the starch and boil as quick as you can—put some diastase into the water as well as the starch—and put it in cold water. It would be impossible for you to boil it too quick. You will not get a large production of sugar. Mix some of the saliva with the cooked starch; put it in your mouth, and then put it in the test-tube and boil as quick as you can, and you will find that there has been a little sugar formed, if you make your test accurately enough; why? because the temperature comes up, till you reach 14 (?)—then the diastase instantly converts the starch with which it comes in contact.
into sugar. When the liver of an animal is thrown into boiling water, the heat gradually penetrates the mass, and there is a fermenting substance present, which has the power, when the temperature is right, to convert glycogen into sugar; such a ferment exists in the blood. There is almost no fluid in the body which has not power to convert starch into sugar. The blood itself has power to convert starch into sugar; the bile also has a little of that property.

So you see that there are, in the liver, substances which have power to convert starch into sugar. This experiment has been made---to take the liver of an animal and instantaneously freeze it out of slices and freeze it instantly, because, as the temperature goes down, the activity of the ferment diminishes, whereas, when you boil it, the temperature rises, and the activity of the ferment increases. It has been found that if you take the liver, boil it and chop it up and grind it up fine and put it away until it begins to decay, and then make a test for sugar, and then make a test for sugar, you will find that there is no sugar there. This is an important fact...

I think Dr. Pavy is right, but thought differently when a student. with him. Dr. Pavy and Dr. Flint had a discussion about it. Dr. Pavy made his experiments in 1872, and my last year in school there (in the Bellevue Hospital) was in 1874. Dr. Flint showed, right in our presence, that the liver forms sugar after the death of the animal, and the longer we waited after the death if the animal, the more sugar there was formed. So I took the ground that Pavy was mistaken. But Pavy has been making experiments during the last thirty years, and has finally demonstrated, and I think, conclusively, that he was right, and that the majority of physiologists were wrong. Pavy was Professor of Physiology in a large London medical college.
Now let us come back to our original question,—and that is, that the body stores up energy in the shape of material which can be acted upon by ferments,—material which must be hydrated before it can be oxidized, and this hydration process takes place under the influence of ferments. There are ferments in the body, and there are ferments in the muscles which act upon glycogen, converting it into sugar, and in this form it is oxidized, and that takes place in the process of muscular activity. Glycogen is one thing which acts upon proteins—and what else? ("Fats.") What else? ("Nucleins.") The nucleins have been classed with the albumens, but Dr. Hall says that stands by itself. When starch is oxidized, it produces CO; and when fat is oxidized, it produces the same thing, because in the oxidation of fat, the fat is converted into glycogen, and then it is utilized. Fat is the form for storage, but it must be converted into sugar or something resembling it before it can be used. These are all oxidizable substances, and in their burning we have heat produced, and we have muscular energy.

There is another substance which must be oxidized—and what is that? ("Nucleins.") And the oxidation of the nucleins takes place in connection with the activity of the cells, so that the uric acid which appears in the urine changes the cleavage product of this nuclear activity, and is a measure of the activity of the cells of the body. That is a very important fact which is to be utilized in the future. Is is not only a measure of cell-activity, but a measure of the vital capacity of the body as well.... We must exclude the CO of uric acid from the food, so that the only source of uric acid shall be the cells themselves.

Now if you are going to measure the product of the oxidation of starch, or the burning of the glucogens or of the fat in the body, you must be careful that the CO that you measure from your lungs don't come from the burning of a lamp or gas-jet,—you should not have
a gas-jet burning and drink Selzer Water at the same time, because it would appear that the CO₂ came from some other source. So, in order to know what the body is doing, we must exclude uric acid from our diet. All these purin bodies must be entirely excluded from our diet bill of fare. This investigation tends to show that uric acid has no business in our food, and that we have no business to eat foods of any kind which contain uric acid, because uric acid is a product of the activity of the cells, and in a downward direction and not in an upward direction. Now we will come back again.

When we have a patient who needs constructive metabolism, if we give him hot applications or such treatment as produces destructive metabolism and increases the destruction of nucleins, he is going to get weaker every day. His muscular capacity will depend upon the amount of glycogen stored up in the mucous membranes, and his nerve-strength will depend upon the amount of nuclein stored up in his nerve-cells. There are other conditions in which this rule applies, but this is the primary one. So, if we give the patient who needs constructive metabolism, stimulations or anything that will make him sweat, we will know that his blood-temperature has been raised by his sweating, and if the blood-temperature has been increased, there has been an increased consumption of nuclein and of glycogen, because the raising of the blood-temperature stimulates the cells to an excessive degree of activity and the patient will necessarily be weaker afterward, because of the consumption of glycogen and nuclein. This is an important principle, so much so that I wish I could impress it upon your minds so deeply that you would never forget it. I can't tell you how trouble I have had, because of the neglect of this fact during the thirty years that I have been connected with this Institution, because this fact did not seem to be re-
alized. I have not known all the reasons why, but I knew by experience that hot applications make a patient weak—"Doctor, I am weak; I have pain in the back, and I want a fomentation to-day." The doctor yields to his importunities and gives him a hot fomentation, and he feels so much relief that he says "I wish I could have a hot fomentation every day." So the fomentations are continued, and the patient thinks he is getting better, but by-and-by he wakes up to the fact that he has lost five or six pounds of flesh, and he is so weak that he can hardly go around his room. He says, "At first I could walk to town and back, but now I can't walk half way there." Such patients would come to me for an explanation of this increasing weakness. I have learned when to use these hot applications since Hall's experiments. He has given us a light which explains these facts which fit into our experience and our work. So I am very much interested in what he is doing so I shall continue to watch his work. I had a very interesting letter from Dr. Haig, a year or two ago, and he states that he recognizes Dr. Hall's work as one of very extremely valuable character, because of the precision with which his laboratory work is done. Dr. Haig speaks of Mr. Horace Fletcher, and of the great laboratory which he and Dr. Gage are preparing, and he says, "I believe that some of the most highly important observations can be made without expensive apparatus in laboratories, for I consider that, after all, the physiological test is the right test," and he is right about it. He wants to know the results of our observations on beans with their skins, and without their skins, etc. I am sure that what we do in that line of work, if it is done accurately and carefully, will be recognized as a valuable contribution to the science of nutrition.
Q. Some people claim that taking nuclein as food is dangerous.

A. We must take foods that the body can use. The body cannot take uric acid and make good nuclein out of it; and the same is true of xanthin and similar substances. The body seems to know how to make proteins out of the most ordinary materials, just as a plant takes crude materials and makes various colors for its flowers, making chlorophyll and other things out of simple things which the plant utilizes. In regard to taking nuclein as food, we may take nuclein whenever we take albumen, and any substance which is rich in albumen will be rich in nuclein; we can take nuclein without danger in connection with any substance which is rich in albumen, for after doing so, we find no xanthine or similar bodies—at least we find no increase of them.
MEDICAL LECTURE, Jan 1, 1903.

Therapeutics, con.

J. H. Kellogg, M.D.

Let us see if we cannot clear up some obscure questions to-day.

We were talking about the effects of heat upon metabolism. As heat increases, the temperature of the blood rises; it increases cell-activity of all sorts, and thus increases metabolism, but it must be applied in such a way as to raise the temperature of the blood. Heat is always a stimulant when communicated in such a way as to raise the temperature of the part to which it is applied. Heat acts reflexly as a stimulant. High temperature has the same effect as a low temperature, at first, but, as the cells and tissues are excited, the heat-regulating centers are also excited, hence there is a diminution in the heat production. When heat is applied to the skin at a high temperature, the effect is exciting and exciting, just as when cold is applied. Cold excites the cold nerves, and heat excites the heat-nerves. So, reflexly, both heat and cold are excitants. But when the temperature of an individual is lowered, its activity is diminished, and when its temperature is raised, its activity is increased. Heat applied to the surface of the body excites the heat-nerves. Now, as the effect of this, the nerve-connections for the heat-nerves are such that while the excitatory effect occurs, there is an excitation of the heat inhibitory center, so that heat-production is diminished reflexly.

There are other exciting effects produced by the application of heat. A short application of heat over a muscle excites the activity of the muscle, just as does a short application of cold. A treatment by
Application of heat over a muscle lowers the excitability of the muscle; have you found that to be the case? ("Yes.") Will a long application of cold raise the excitability of a muscle? ("No; a long application of cold acts the same as a long application of heat.") Yes,--the effect of cold is much more prolonged than that of heat. ... So the reflex excitant effects of cold and heat are practically the same. They are practically identical. That simplifies things, because cold excites the cold-nerves, and heat excites the heat-nerves. Now the cold-nerves have such a relation with the heat-generating centers--the thermogenetic centers that it stimulates heat-production reflexly, while the heat-regulating, or thermogenic centers (illustrating and explaining by diagram.) So that there is a reflex diminution of heat production. That is the difference between the two. The effect is, to excite the inhibitory center...

Hydrotherapy has been an empirical system for so many centuries that it is difficult to get out of empiricism,--even Sanitarium doctors, a Medical Missionary doctors. College doctors are still in the rut of empiricism--doing things because someone else does them--finding out what the custom at the Sanitarium is, or what a Sanitarium doctor recommended, and they remember that and practice it. But I hope that none of you will do a thing simply because you have seen some doctor do it; you must do it with a full knowledge of the physiological basis of treatment on which the physiological measure rests.

Now, in relation to metabolism, what will heat do? There is one thing it will do,--it will aid in the formation of antitoxins and alexins. An elevated temperature of the blood is always which is the result of the application of heat may have the effect to encourage the formation of alexins and antitoxins. We may conceive that the reason nature
establishes, in the case of fever (as a prolonged fever, like typhoid) a higher standard of temperature—what is the standard of temperature in typhoid fever? ("101° to 101 1/2°") It doubtless varies with individuals, but that is about the average. What is about the natural temperature of a person with typhoid fever; you don’t expect the temperature to be is going below that. I don’t know that we want the temperature below that, because this elevation of temperature in fevers has been proven to be the means of cure. Hippocrates knew that away back, two thousand years ago. But this fact seems to have been lost sight of. He recognized this rise of temperature in fevers as a curative condition, but that fact has been lost sight of, in recent times. In recent times it was brought forward in the International Congress in Rome a dozen years ago. I was glad to hear that, because it was a recognition of the physiological process of healing, by the medical profession. It was important, because, when it was understood that fever was controlled and helped in this way, that was an open door for many other things which would be recognized, as well, so I felt greatly pleased to see it.

Now that fact has been followed up: Dr. Hair, of Philadelphia, some years ago made some experiments with the antitoxin of diphtheria, and he found that when he injected some of this under the skin—first, he introduced some of the cultures of Loeffler's bacillus—a diphtheria culture, and he injected an antitoxin of a given amount might along with it—and to some animals he applied heat, and to some, he did not, and the activity of the antitoxin was increased by heat. In the ear of one rabbit he injected a streptococcus culture, and in another rabbit there was injected another culture of the same kind and amount. A bag filled with hot water was put round one ear of one of the rabbits, while the other ear was left to the efforts of nature unaided.
well quicker than the other ear,—the healing process was accelerated by the heat. So we see that heat has the effect to stimulate and encourage the development of the defence of the body. This is a very interesting and useful thing to know.

We see here, the reason why we apply poultices to boils and hot applications in appendicitis. We see why liquefaction, as the old fashioned linseed poultice, the bread-and-milk poultice, and the fig poultice were all physiological measures, and had a sound scientific basis.

These methods did not designate with scientific men, but out of the experience of common men. I have seen some medical journals lately which spoke very disparagingly of empirical hydrotherapy, cold-water cures, etc. I found an article by Professor Strausser, who is a professor in the Vienna Medical College, and assistant of Professor Winternitz, having charge of the great International Clinical Laboratory, and Professor of Nervous Disease. In a paper in which he describes the methods of Professor Winternitz, he says that the method of Winternitz is based on that of Priessnitz. That means agreed altogether. Priessnitz was a poor peasant of Austrian Silesia. He didn't know how to write till he was thirty years old. He had to be taught writing when he was thirty years old, although he built up a great institution—he could barely read, but he couldn't write. And this is the man who originated and developed the system which Professor Winternitz is willing to recognize as the basis of his system. I noticed that when I was with Winternitz in his institution,—I saw that his methods were the methods of Priessnitz. When I was at Graefenberg, I became familiar with the methods of Priessnitz, and I afterwards found that the methods of Professor Winternitz were identical with those of Priessnitz. These
methods which have spread so far and wide—the application of the wet-sheet pack, the compress, etc.—were all originated by Priessnitz. He invented most of the hydraulic methods. I think I will show you at some time how he applied his compresses to dogs and men and horses, and generalized his methods in a remarkable way.

The same thing is true of many of the most valuable remedies we have. Even the application of electricity, in large part, is the result of the labors of many men who were called "empirics" but whose methods were based upon the findings of experience, and which were not the outgrowth of laboratory researches. Laboratory research generally comes along afterwards to confirm the observations of experience. Experience is a great teacher. Nature is the great teacher, after all. We do not learn much teaching from scientific men. Most of our valuable discoveries came not from scientific men. And great inventions did not come from scientific men, but from common men. Edison was once an ignorant newsboy; he was a train-boy and sold newspapers on the cars up in Northern Saginaw, Mich. He went to school but little. He became a telegraph operator, and finally became the most rapid telegraph operator. He was the man who originated the "round-hand" writing, because he could not write fast enough to keep up with the telegraph operators. The story is told of him that he was taken down to New York to compete with some Washington operators. They had a "crack operator," and they wanted to see Edison "fall down," so he was put on, and he kept up with the other operator for four hours, and then the Washington operator in Washington wanted to know who was at the other end of the line, saying that "it must be either Edison or the Devil," for there was nobody else who could that he knew of, who could take messages at that rate. His idea was to increase the speed of telegraphy, and he did so by increasing the speed of writing, and he could take a telegraphic message faster than any
other operator by the use of his new system of writing. He invented a method by which he could send eight messages at the same time. I was with him when he was making experiments in sending messages. I spent a whole afternoon with himself and a friend. He had just discovered what he called the new force—the odilic force. He divided that force until he had a form of electricity which would jump, and he showed me how it would jump. He made it jump three feet in his laboratory, and then he made it jump five feet. He found it out with his telegraph sounder, and he found that if he attached the wire to this sounder in a certain way, he could take that wire out of his laboratory and run it out-of-doors, insulating it and bringing it back into his laboratory, and then putting up a big sheet of metal six or eight feet away, and then by placing a pin-point on the metal, he could draw a spark off the end of that wire—in other words, the electricity had jumped from one point to the other and drawn off a spark. Edison went on developing this method until he perfected it so that he could get a strong current, and this is what he called "the grasshopper force." It was not insulated until the wire was run out into the gutter, and so he called it the "odilic force," but when he found out how it was, he called it the "grasshopper electricity." He transmitted messages on trains of cars—here is a telegraph wire on a train (Diagram.) He worked then with a piece of tin foil. There was a message that came over the wire and it could be caught by this instrument—that is, by his "grasshopper electricity." This system has been developed until Marconi makes it leap across the ocean,—it was claimed that a message passed through the air from Ireland to Nova Scotia. Now Edison is an uneducated man. He was an ignorant boy and worked his way along up, until he is now the greatest inventor of
the age. I remember the different steps by which electric lights etc. were developed. Thomas Edison was the first man to use these things, --I followed these steps very closely, especially since I have been more or less acquainted with Mr. Edison--ever since about thirty years ago.

The same is true with reference to almost every valuable invention they are made by common men, through their contact with nature--men who were unprejudiced by precedents. This prejudice, as a rule, has been a great obstacle in the way of scientific men. This has been a burden on my mind when I have been thinking of the work of medical men, in reference to these physiological methods. We have all these great principles of truth have come from common men. And what is true in this respect is true also in theology. Theologians are farthest away from religious truth. If there is a new truth that comes to us, it comes from the most common men. Why is that? It is because of the power of precedent to hold men down; it is because men don't dare to think except as other men have thought--it is the power of hoary-headed opinion which has such a power to hold men down that they don't dare to think independently.

It was been discovered in early ages that heat stimulates reparative processes; it aids in the formation of antitoxins and alexins. We have many illustrations of this. Some years ago, I had a dog who had the toothache. Sometimes, when he had a good deal of pain, he would groan, and lie down and put his paw up against his tooth. I have seen boys do that when they had the toothache--in fact I have done it myself when I had the toothache--that is the natural thing to do. I saw a very interesting thing at San Diego, Cal., at Corrientes Beach. We came across a monkey-house (and I am always in-
interested in such things) and I stopped there, and saw a little monkey who evidently had a fit of indigestion, and there was a large monkey—they were in a cage, and the little monkey pressed his stomach against a steam-pipe to get a fomentation. There were some nuts that had been thrown into the cage, and the little monkey wanted some of them but the old monkey would not permit him to have them. We see the same thing in other animals—when a dog has pain in his stomach, he will always curl himself up, so as to protect his sensitive stomach. You will see patients who have pain in their bowels, draw their knees as near to their chin as possible. It is a natural instinct which teaches one to curl up and retain the heat of the body as much as possible, by bringing the body into as small a space as possible.

MISS EVANS: Our dog "Don" used to lay his head on the window sill when he had a sore throat.

DR. KELLOGG: Yes,—he made an application of hydrotherapy instinctively. Hydrotherapy does not come from the laboratory, but from the great heart of nature. A savage is just as likely—and more likely—to discover a great principle in hydrotherapy, than is the scientific man in his laboratory, because he is nearer to nature than the scientific man is, and his mind is unprejudiced.

Q. Were the discoveries of Priessnitz more important than those of Kneipp?

A. Pastor Kneipp got his ideas from Priessnitz' book. I have a biography of Priessnitz and his entire work. It also gives an account of the manner in which Kneipp got his inspiration. The system of Kneipp is not original. He visited Berlin and found a little book by Priessnitz in the library there, and that contained Priessnitz' system. I have looked over the Kneipp system pretty thoroughly, and I find nothing
in the system of Kneipp that Priessnitz did not do—the walking in the wet grass in the meadows, sleeping in a wet-sheet compress—every single thing that Kneipp did, Priessnitz had done before. Priessnitz began his work about 1813, and Kneipp began his work twenty or thirty years later.

These methods are all good, only some of them are rather crude and need the control of careful diagnoses; but the methods themselves are all of them very effective. The difficulty is, that they are used in an unscientific manner, because those who used these methods lacked the power to make accurate diagnoses—that is where the evil comes in—the principles themselves are sound.

I don't think we should encourage Kneippism, and I don't think we should attack it; I am careful not to do that. If you will look back numbers of Good Health over, you will find that we have not burdened our pages with attacks upon Kneipp. We sometimes refer to crude methods, but we don't attack Kneipp—we don't use our powder in that way, because he is working in the direction of truth. You know we don't endorse Osteopathy, and yet look through Good Health from beginning to end, and you won't find anything in it condemning Osteopathy. The Osteopathists are working in the right direction. We cannot stand with them and endorse them, because their methods are empirical, and they claim ridiculous things for their system, so we can't stand with them—but we don't want to fight them. It is a good thing for Osteopathists to do, to break down faith in drugs—they are undermining the confidence of people in drugs, and so I don't feel that we should condemn them. There is also a more important principle involved, and that is, that a man who knows something that will help his fellow man, has a right to use it; there is nothing which can rightfully prevent that. Men have certain
inalienable rights. But the tendency is, for professional men to invade the rights of others—to make classes and monopolies. If there is anything that a man loves more than anything else, it is, to have a monopoly of something. When I was down South, and a colored man was shaving me, he claimed to have an improvement on his razor, and he showed me a cross-section of it. (Illustrating by diagram.) He charged me twenty-five cents for shaving me, and I said, "Isn't that rather a high price for a poor shave?" "Why, massa," said he, "I've got a mon-o-poly ob dis bizness." Men are working for a "mon-o-poly" of something. There is now a movement on foot to make a law in Michigan to the effect that every one who attends a medical college shall be examined by the State Board before he can receive a diploma; and any one who provides very stringent measures against anyone shall practice medicine without the authority of the State Board. There is another clause stating that there is nothing in this "Act" which shall interfere with any person's doing anything that he knows how to do to help another in case of emergency, or with the administration of family medicines by family physicians (?) I don't exactly like this last clause, nevertheless the idea is right.

The Osteopaths are winning battles everywhere. There has been great efforts made in different States to make laws to prohibit them from practicing, but they are winning battles in New York and elsewhere. They had a great contest of this kind some time since, in New York, and they employed "Mark Twain" (who is not a lawyer) to plead their cause before the Legislature. In the course of his argument, he said: "You may make what laws you please, but you can't make laws by which you can prevent our grandmothers for giving herb teas as medicine—you can't take them to jail if they do. The people won't stand by you if you undertake to administer such laws." He also said, "I
was down in New Orleans when I was a boy, and one day when I was walking on the street, I saw a couple of colored men looking at a picture (it was before the war). He said it was the picture of Jesus healing the blind man. In the picture there were some men who were looking very savagely at him. One colored man said to the other, 'What is that picture any way?' The other man replied, 'It is Christ healing the blind man.' Then he asked, 'Who are those fellows over there, looking so cross at the Savior?' 'Why,' said the other colored man, 'those are some policemen, I expect, who are coming to arrest Jesus for practicing without a license.' And said Mark Twain, 'If Jesus Christ was here today healing the sick, you would arrest him and put him in jail for ignoring your man-made laws and your licenses which invade the rights of man.' He made the thing appear so ridiculous that the Osteopaths escaped, and the Bill to prevent their practicing was not passed. And I think it should not have passed. I think they should be allowed to go on. Of course they are doing harm and mischief, but it is impossible to make laws which will prevent a man from doing mischief which will not stand in the way of other men doing good. We have got to leave room for men to do wrong, in order that they may have a proper opportunity to do right. There must be liberty for action. These men are really doing some good. We will have to come in contact more or less with these questions, so it is proper for us to discuss them a little.

Just a few words upon the effects upon internal parts by external applications. The effects of short hot and cold applications are the same (?). It relieves increases the excitability of the muscles, and relieves the sensation of fatigue. So a very hot bath would be a very good thing for an exhausted man. Some time ago, I found in an old book, an account of the manner in which an English gentleman, 150
years ago completely revived a company of exhausted soldiers by giving them a hot emma when they were in a state of collapse. The injection of hot water into their bowels relieved them. Now this was not the regimental doctor who administered this sensible remedy—it was the General. That was the thing to do in that case, because it increased the blood-pressure. Experiments recently made, show that hot water injected into the bowels increases the blood-pressure at once. These men were exhausted, but by this application the tone of the heart was increased, the blood-pressure was increased, and that revived them. A short hot-bath has the same effect. The application of hot water to the nerves of the skin, and to the nerves of the mucous membrane will produce identical effects—the effects are the same whether you apply hot water to the mucous membrane or to the skin. The heat comes in contact with the peripheral nerves, and the effects of heat are the same upon the general system.

Now the effect of heat upon the internal viscera—upon the stomach, for example—we will say, over the heart,—a very short hot application over the heart has the same effect as a short cold application; but a prolonged application over the heart is detrimental. I do not much approve of alternate hot and cold applications over the heart; it is seldom necessary, because the heart is protected by the clothing. We may expect that when heat is applied, it will be applied too long, and the patient will be overheated—when we apply heat over the heart, we are likely to apply it to the large blood-vessels about the neck, and the brain will be affected. So I think it is better, in making an application of heat over the heart, except in extreme cases in which we want a powerful effect, to apply heat fifteen or twenty seconds—just long enough to redder the skin, and then apply the cold. I am not sure but that the application of cold for twenty seconds will do everyt
thing that the heat will do, and is a more powerful stimulant. Which are the more sensitive, -- the cold nerves or the heat-nerves? ("The cold nerves") Yes. The difference between the temperature of the cold application and that of the skin is greater than the difference between the temperature of the hot application and that of the skin. You can't bear an application of a temperature higher than 120° or 130°. So the difference is not so great in hot applications and the normal temperature of the skin (which is about 100°), and the temperature of ice or water at 32° -- the difference being about 32° in the cold application, and the difference between the hot application and that of the skin would be only about 20°. So the difference between the cold application and the normal temperature of the skin is about twice as great as the difference between the hot application and the normal temperature. Besides, the cold-nerves are more sensitive than the heat-nerves. So here we have two factors in the production of these effects. This shows us that we can get more powerful effects from cold than from heat.

Q. In the case of soldiers, does the cold bath have a better effect than the warm bath -- hot enema?

A. I think not. Alexander the Great, you remember, lost his life by plunging into cold water by plunging into cold water when fatigued. When the Romans invaded Britain, about three hundred years after Christ, one of the Roman generals was killed by entering a cold bath after a long and tedious march. Cases of this sort are frequently reported. A hundred years ago, the medical journals were filled with reports of persons who had been killed by drinking large quantities of cold water or after taking a cold bath when fatigued or exhausted (?) There was much speculation as to the cause of this. They did not
understand the facts which have since been developed brought to light,—that when the body is fatigued the nerve-centers are unable to react to the application of cold, and that when the nerve-centers are fatigued and cannot react, then the application of cold is dangerous because the blood is driven into the interior, and does not return. So, in the case of those exhausted soldiers a cold application, under ordinary circumstances, would have been a dangerous thing. Now if a trained nurse, or student of the Medical Missionary College had had access to those soldiers, he might have brought them through by applications of cold over the heart, with rubbing the chest, then rubbing with a cold cloth, rubbing one arm until it was red, and then the other arm, and so on, accompanying the cold application with vigorous rubbing—partial cold rubbings—and that would have been safe; but they didn't know enough for that in those days. They used to plunge a man right into the river or stream, or they would dash cold water over him, the patient, and he could not react to such a large application of cold, and so he would die of collapse; so the hot application was better than the cold—a general very short hot bath is better than a cold bath when a person is exhausted. A hot enema is useful, but a cold enema would chill the patient, if applied when he is exhausted. When a person has been exhausted by a long march, for example, his glycogen is exhausted, and his power to make heat as well as his power to do work are equally diminished,—when his power to make heat is exhausted, his power to do work is also exhausted, because the same muscles are involved... Nature will tell you when to take cold water—when you dread it, don't take it, until trained to do so. We must have careful training by partial applications,—to the face, to the chest to one arm, then the other arm, and so on until you go over the whole body, all at one time; but you must not go over the whole body at first.
Many people cannot take a general cold bath with safety,—they will have a blue surface, blue skin etc., and in such a condition a general cold bath would be injurious,—never give a cold bath when it leaves the patient in that condition, as it would certainly have a damaging effect upon the body. If you find such a condition after the bath—a blue surface, cold hands and feet, blue finger-nails, etc.,—the patient has not reacted well; you should manage the bath in such a manner as to secure a good reaction,—first take a very short hot bath; then take a short cold bath of each of the parts, as I have stated, taking first the upper part of the body, then the other parts.

Q. Would it be proper to take exercise after the bath,—let him become warm by exercise, and give him a hot application?

A. The best way is to take exercise before the bath; then take the bath, and have a cold application; then take exercise again. But be careful not to take so much exercise as to become tired and out of breath when you have a cold bath.

A word more in reference to the effects of heat: Pushkin, a German investigator, has shown by actual experiment, that a long continued hot application over the stomach increases the amount of hydrochloric acid and improves digestion. This is an experiment which can be easily repeated. I have made a number of experiments which seem to teach the same thing, and to show that he is right about it,—and I think he is. This hot application, however, must be confined to the reflex area of the stomach, and must not be a large application, and must not cause the patient to sweat; if it causes him to sweat, it will diminish the power of digestion, because then the chlorides are lost,—and they are the sources from which the hydrochloric acid is made. There should be a hot application over the stomach, and it must be applied over
the gastric area of the skin; if you make the application to a large area, you may overheat the blood, for example, if the application covers one-fourth of the skin, it will heat the blood; it must not lower the temperature of the blood. If the application covers four or five feet, it will heat the blood, and that will cause perspiration, and a filling of the surface vessels with blood, which will divert it from the stomach, and carry away the chlorides out of the blood, thus lessening the formation of hydrochloric acid, and lessening the formation of pepsin, the glands will not be filled with blood, and consequently the gastric juice will be deficient in quantity and quality.

Now, to get this effect that we desire,—that is, the an increase of the movement of the blood through the stomach, kidney, liver, etc., and to stimulate the formation of gastric juice, the hot application must be confined to the reflex gastric area... As to applications, I have learned that a hot bag is better than a fomentation. Many patients are injured by sweating on the application of a fomentation, but not by a hot bag. I had one made for this purpose. (Illustrating and explaining by diagram.) I had this made to apply over the stomach,—I had these rubber bags made, as they were more convenient—they are commonly called "stomach-bags."—that is the old name they had 25 years ago—we called it a "stomacher" in those days... We had a great many crudities then, which have since disappeared, although we still have some of them sticking to us. Now Dewalski (?) has found that a hot application followed by a cold application increases the activity of the liver in producing bile. So we have these two facts, which are useful to us in practice,—that we may increase the activity of the stomach by a long continued hot application over the stomach, and that the activity of the liver may be increased encouraged by a foment-
ation followed by a heating compress, and this seems to encourage the action of the liver, because we dilate the liver vessel first with a hot application. We make a hot application for five to ten minutes. It is only necessary to make an application sufficient to dilate the surface vessels, then the vessels of the liver are also dilated. Then, when we make a cold application what happens to the liver vessels? ("They contract.") What directly follows that contraction? ("A dilatation and reaction.") A reflex reaction and dilatation—

Q. Would not the effect of an alternate hot and cold douche be about the same??

A. I think the effect is prolonged by the application of a heating compress over the liver. This should be applied with water, because this stimulates the activity of the hepatic vessels, and thus the blood is moved through them more rapidly,—and this is also a tonic dilatation instead of a passive dilatation.