doing. More difficult "feeding cases" are due to a chronic impairment of fat absorption than to any other cause, and this is brought about by the combination of the calcium of the cow's milk with the free volatile fatty acids present, forming insoluble calcium soaps, which cannot be absorbed, thus causing a great loss of calcium and of fat in the stools. A great many cases of rickets are undoubtedly caused in this way, and I believe that when we have more light on the chemical processes that bring about this difficulty of fat absorption, we shall be able to deal with our cases of malnutrition much more intelligently than we do now. At present it is true that we get good results in many of our cases of chronic fat indigestion, by simply cutting down the fat in the diet, and perhaps raising the other food elements to make up the calories. This, however, is begging the question; what we should be able to do is to feed such a milk to our babies that insoluble calcium soap formation will not go on, and this is the goal toward which all Mr. Bosworth's work points.

MR. BOSWORTH: In connection with what Dr. Hill has just said, it may be of interest to you to know that the soap in infants' stools is calcium soap of palmitic acid, calcium palmitate being very insoluble. If you take the calcium out of the food of a child showing an intolerance for fat with a high content of soap in the stool, the soaps disappear entirely. A child giving off 15 grammes of soap in twenty-four hours will give off about 3/10 gramme of soap in the next twenty-four hours if the calcium is removed from the food.

DR. LADD: I would like to ask if there are any soluble calcium soaps?

MR. BOSWORTH: The soaps of the lower fatty acids are soluble, and there is a degree of solubility, of course. Palmitic acid is the most insoluble of the fatty acids in cow's milk. This is due to the fact that the melting-point is high. The solubility and the melting-point are hitched up together in some way. The melting-point of palmitic acid is 62° C., quite a bit above body heat.

BASIC PRINCIPLES IN THE SYMPTOMATOLOGY OF BRIGHT'S DISEASE.

By H. ELWYN, M.D., NEW YORK CITY.

IN reading current literature on Bright's disease we are confronted with the description of a multiplicity of types. There is the hypertensive type and the non-hypertensive type, the nitrogen-retention type, the sodium-chloride-retention type, etc. All these descriptions have this fundamentally wrong with them,—that they attach too much importance to a single symptom, without emphasizing the uniform principle practically underlying all cases of Bright's disease.

In studying diffuse kidney diseases there are the three elements of the kidney which we have to consider, namely: tubules, glomeruli and vessels of the kidney. Volhard and Fahr, in their

remarkable monograph on Bright's disease, have well demonstrated that each of these elements, when diseased, will produce a characteristic symptom-complex, and that we can well infer, from the symptoms presented, the exact histological picture of the diseased kidney; and this without the aid of dye tests, mathematical formulæ and other cumbersome procedures.

As prolegomenon to correct understanding, we have to consider what is the essential function of the kidneys; what is meant by a sufficient kidney and by an insufficient kidney; what elements are involved in kidney insufficiency; what is the compensatory mechanism, and finally what is the ultimate result of kidney insufficiency.

The function of the kidney is to excrete the waste products of metabolism. Of the various waste products, the non-protein nitrogenous substances, chiefly urea, form the most important elements. The necessity of their excretion is a matter of life or death. Inability to excrete them invariably leads to death in a short time, after a certain amount has accumulated in the body tissues. Not so with the mineral salts. Retention of sodium chloride may last for months; it favors edema, water retention and cardiac insufficiency, but is never the immediate cause of death.

We may consider, then, as the *essential function* of the kidney, the elimination from the body of the nitrogenous substances in the form of the non-protein nitrogen, and, indirectly, the maintenance of a normal level of the so-called rest nitrogen in the blood. This level, Folin and his co-workers have definitely proven to be, in normal health, 23 to 27 mgm. per 100 cc. of blood. The excretion of these products is effected in a solution, which the kidney can either concentrate to a high degree, so as to save fluids for the body, or eliminate in a very low dilution with a sufficient quantity of fluid intake. We can measure this ability of the kidney to concentrate by the specific gravity of the urine, which reaches, with a normal kidney, to above 1040. This ability to concentrate or dilute, according to needs, we call the *variability of kidney functions*, and it forms the essential means of the proper functioning of every normal kidney.

By a sufficient kidney, we mean a kidney that is able to eliminate the essential waste products under a variety of conditions with a variability of function. And we mean by an insufficient kidney one which loses this variability of function, and must either use a compensatory mechanism to help eliminate the waste products, or else fail to do so, entirely.

Variability of kidney function is dependent entirely upon the integrity of a sufficient number of glomeruli, and reduction of the functional capacity of the glomeruli to a sufficient degree, by inflammation or chronic obliteration, will result in a gradually increasing loss of this

variability of function. The result is a urine of low dilution, and in order to excrete all the waste products, the kidney must excrete continuously of this greatly diluted urine. But water excretion is dependent on glomerular function, and with the reduction of glomerular function, water excretion is impaired. The only thing that the kidney can do is to force enough water through those glomeruli that are still functionally capable, and it does this by raising the pressure in the glomeruli and, of course, in the whole arterial system.

The compensatory mechanism, then, consists in hypertension and increased diuresis of a hyposthenuric urine. Obliteration of the glomeruli to a point where, with hypertension and increased diuresis, the kidney fails to eliminate all nitrogenous waste substances, will result in an increase of the rest nitrogen level in the blood, progressive to a degree where death results. The same will result when the blood pressure falls, for any reason, to a degree where the compensatory mechanism breaks down.

By taking the specific gravity of the urine over a prolonged period of time, we can well establish the variability of which the kidney is capable. By giving the patient an additional water intake, we can see how promptly it is excreted, and by placing him on an absolutely dry diet, how high he can raise the specific gravity of the urine. Increased amount of rest nitrogen in the blood always means manifest kidney insufficiency, capable of returning to normal when the glomeruli are acutely inflamed, but always progressive where the glomeruli are permanently obliterated.

With these considerations let us review the various forms of diffuse kidney disease.

In acute diffuse glomerulo-nephritis we have a condition in which all the glomeruli are hit. The causal agent is always bacterial in origin, with the streptococcus in the lead. Although all the glomeruli are involved, they are not equally so, and side by side with bloodless, swollen glomeruli, with proliferation of cellular elements, there are glomeruli whose capillaries still contain blood and are, in a measure, functionally capable. Applying our tests for kidney insufficiency, we find that variability of function is diminished in proportion as the glomeruli are affected, and that retention of non-protein nitrogen in the blood is in inverse proportion to the ability of the compensatory mechanism to maintain diuresis through the less affected glomeruli.

As an expression of acute inflammation there is hematuria. This in diffuse kidney lesions is always a symptom of acute glomerular involvement. With the blood in the urine there is always slight albuminuria and cylindruria. Cases of acute diffuse glomerulo-nephritis are hardly ever pure, and nearly always there is a secondary tubular degeneration which expresses itself, clinically, by generalized edema,

cavity hydrops of a pseudochylous transudate, marked albuminuria and cylindruria.

The clinical picture of acute diffuse glomerulo-nephritis, as we see it, is, therefore: a hemorrhagic urine with some albuminuria and cylindruria; an increase in blood pressure as an attempt of the compensatory mechanism to maintain normal diuresis. If the inflammation is very slight and there is sufficient glomerular functional power to maintain the essential function of the kidneys, there will be no rest nitrogen retention in the blood, and practically the only symptoms presented, besides the urinary findings, will be a concentration ability of probably not above 1025, and an increase in blood pressure of perhaps 20 to 30 mm. of mercury above the normal. This, also, is often the picture in an inflammation which is beginning to recede.

With a severe inflammation, concentration ability hardly rises above 1018 to 1020, and although the compensatory mechanism of hypertension may result in a systolic blood pressure of 180 to 200 mm. of mercury, there is still so great a loss of glomerular functional power, that the essential function of the kidney cannot be maintained, with the result that the rest nitrogen level in the blood is increased and may exceed 80 and 100 mgm. per 100 cc. of blood.

In most of these cases of acute diffuse glomerulo-nephritis *restitutio ad integrum* is possible. The indication for treatment is: rest in bed till all signs have disappeared, a minimal protein intake, and a salt-free diet if edema is present. A gradual fall in blood pressure and of the rest nitrogen level in the blood, an increased concentration ability, together with the disappearance of blood from the urine, are the signs of betterment. Usually the blood pressure is last to return to normal, and in this connection a knowledge of the individual is important. In an individual who before the attack of acute nephritis has been carrying a blood pressure of 150, we should not expect to have it return to a lower level with the subsidence of the acute attack.

There is really nothing in kidney pathology that one can confuse with this picture. For in cases of focal nephritis or of the embolic glomerulo-nephritis of streptococcus viridans endocarditis, where the hematuria indicates acute glomerular lesions, although conceivable, there is practically never any kidney insufficiency, and therefore no loss of functional variability, no increase in blood pressure, no increased rest nitrogen in the blood.

If the kidney does not recover completely it passes into a chronic diffuse glomerulo-nephritis, in which functional activity is dependent either upon the glomeruli which have recovered completely or upon those which, having undergone chronic inflammatory changes, are still capable of functional activity. Loss of variability of function is a manifest symptom of kidney rest diuresis. The kidney remains sufficient and a

normal level of rest nitrogen in the blood is maintained as long as a sufficient quantity of urine of low dilution can be excreted by this kidney rest with the aid of the compensatory mechanism of hypertension. As long as the kidney is able to do this we may call this the latent stage of chronic diffuse glomerulo-nephritis, to distinguish it from the last stage when the kidney is manifestly insufficient.

We have, then, as the clinical picture of the latent stage of chronic diffuse glomerulo-nephritis: hypertension of 200 to 250 mm. of mercury; polyuria; a concentration ability of about 1020 on a dry diet; a slow elimination of an increased water intake; excretion of all of an extra sodium chloride intake, but over a prolonged period of time and in a urine of low dilution; a trace of albumen in the urine and a normal level of rest nitrogen in the blood.

There is only one other clinical picture for which this stage of nephritis can be mistaken, namely: arteriosclerosis of the kidney, in which the finer and often the finest vessels are involved. The condition is known under various names, as the granular kidney, benign hypertension, simple kidney sclerosis (Volhard and Fahr). It presents, clinically, hypertension reaching 200 mm. of mercury and above, polyuria, nycturia, with traces of albumen in the urine. But in this condition there is no loss of variability of function, ability to concentrate is retained and is very high on a dry diet. An increased water intake is promptly eliminated. The polyuria and nycturia are dependent not upon a kidney rest diuresis, but upon a latent edema due to the relative insufficiency of a hypertrophied heart muscle, which again is the result of prolonged hypertension. This can be well shown by placing the patient on a salt-free diet with a limited water intake and also with absolute rest in bed. The polyuria and nycturia will rapidly diminish and often disappear entirely. In this condition the glomeruli are not diseased at all, the primary condition is that of hypertension, dependent upon changes in the finer vessels of the kidney.

The kidney in the latest stage of chronic diffuse glomerulo-nephritis is prone to acute exacerbations, resulting in a fresh hematuria, diminished diuresis and rest nitrogen retention in the blood. A careful anamnesis and close observation will often establish the latent chronic nephritis previous to the acute exacerbation. Again, we must not consider every case of acute symptoms in an elderly individual with high blood pressure as an acute lighting up of a previous chronic nephritis. This is very important with a view to prognosis.

The latent stage of chronic glomerulo-nephritis may last only a few months, or it may be prolonged over a period of many years. Its course is always progressive, and the clinical cases present a variety of transition forms tending towards the stage of manifest kidney insufficiency. Occasionally we meet with borderline

cases, between the latent and the manifest, especially in individuals who have suffered from gout or have been lead workers, in which the rest nitrogen is often 50 to 60 mgm. per 100 cc. of blood. In such borderline cases a non-protein diet will restore nitrogen level in the blood, and prove that the kidney rest is still capable to maintain the essential function of the kidney, if not subjected to too much strain.

As the chronic glomerulo-nephritis progresses towards its terminal stage, we have manifest kidney insufficiency. As the kidney rest is reduced and its functional capacity diminished more and more, we have practically a total loss of functional variability. Concentration of urine remains fixed at 1006 to 1014. The compensatory mechanism of increased diuresis, although continuously at work night and day, is unable to eliminate the nitrogenous waste products of metabolism, at a minimal non-protein food intake or even at a total absence of protein in the food. The result is a gradually increasing level of rest nitrogen in the blood to a degree where symptoms of poisoning are produced, the figures before death often reaching 300 mgm. per 100 cc. of blood.

Blood pressure is excessively high, often reaching 275 to 300 mm. of mercury. Insufficiency of the hypertrophied heart muscle will complicate the clinical picture. There may be a fall in blood pressure and with the breaking down of the compensatory mechanism of hypertension the quantity of urine will be diminished, and with the increase of rest nitrogen in the blood death will quickly follow.

With the gradual increase of rest nitrogen in the blood there is added the picture of true uremia, that is, of retention of the constituents of the urine in the blood, of the grand azotemia of Widal. The symptoms of true uremia are remarkably uniform. Beginning with anorexia, dyspeptic phenomena of vomiting, thirst and diarrhoea, there is a gradually increasing weakness and feeling of fatigue, apathy passing into drowsiness and stupor. This is accompanied by a characteristic restlessness and increased irritability of the muscles of the extremities, but never developing into convulsions. There is subsultus tendinum. Stupor finally passes into coma in which the pupils are contracted, the reflexes are increased, but there is no Babinski. Respiration is deep and slow, characteristic of states of acidosis. Pericarditis is often present the last few days.

Albuminuric retinitis is as a rule present in most cases in the terminal stage of chronic nephritis. It is often an early sign when the insufficiency of the kidney is still slight. It is never a sign of acute glomerulo-nephritis nor of the second latent stage of chronic glomerulo-nephritis but always a symptom of beginning manifest kidney insufficiency.

In tracing the sufficiency or insufficiency of a kidney through the various stages of glomerular

injury, there is one complication of acute glomerulo-nephritis which we have to consider, namely: eclamptic convulsions. Convulsions do not belong to the picture of pure nephritis in any of its stages, and they practically never occur in the second latent stage or in the third terminal stage, but they are always a complication of the acute stage or of an acute exacerbation in the chronic stage. Acute diffuse glomerulo-nephritis may run without this complication throughout the entire course or may develop convulsions at any time. We do not know the causal mechanism, and the best explanation we can give is the old one of "brain swelling," of extracellular and intracellular edema of the brain centers. To classify a cerebral edema type of uremia, as is done by a recent author, is entirely wrong, as this is only an occasional complication of acute nephritis and is never dependent upon actual kidney insufficiency.

We have mentioned so far the various forms of glomerulo-nephritis and have classified them into: an acute diffuse glomerulo-nephritis, a latent stage of chronic diffuse glomerulo-nephritis, and a terminal stage of chronic diffuse glomerulo-nephritis. We have also mentioned focal glomerulo-nephritis and embolic glomerulo-nephritis as not causing any kidney insufficiency and, therefore, no increase in blood pressure, no loss of variability of function and no increase in the rest nitrogen level in the blood.

In considering tubular involvement there is a good deal of dispute whether to use the term "nephritis" in connection with it or not. Aschoff insists upon the use of the term "tubular nephritis," while others, because of the purely degenerative character of the injury, refuse the use of this term. Fr. Muller has coined the word "nephrosis" for it, which is gradually finding acceptance by German writers.

Purely tubular injury without any glomerular involvement is characterized by marked albuminuria, cylindruria, edema and hydrops of the serous cavities. There is salt retention with the edema, whether because of the edema we do not know. Nor do we know the causative mechanism of the oedema. There is no increase in blood pressure, no loss of concentration ability, no increased rest nitrogen in the blood and no hematuria.

Such forms of pure tubular degeneration or nephrosis are found in the course of chronic suppuration, in tuberculosis, syphilis, diphtheria, and occasionally in other general infections. In many cases no etiology can be discovered. They may be complicated with amyloid deposit, which does not change the clinical picture.

As a special form of nephrosis, we must consider the pregnancy kidney. Here the clinical picture is complicated with eclamptic convulsions and increased blood pressure, which does not stand in any causal relation to the kidney affection, but is probably the result of the same

poison causing the tubular degeneration in the kidney.

A nephrotic kidney without glomerular involvement is never a cause of death. When death occurs it is due to the causative disease or to some intercurrent affection. Convulsions never occur in pure nephroses.

Prognosis depends on the causative disease. Those of unknown etiology may last many years. Treatment is, of course, directed towards the etiological disease, and the edema and cavity hydrops can be controlled remarkably well by a salt-free and a dry diet.

As a special form we must also consider the sublimate kidney. In this condition, instead of a degeneration of tubules we have complete necrosis of tubules. The glomeruli are not affected. Clinically the mild cases are characterized by oliguria, marked albuminuria and cylindruria. In the severe form of bichloride poisoning, there is complete anuria, and with it retention of all the nitrogenous waste products in the blood, increase in blood pressure and the other signs of true uremia in so far as they are not overshadowed by other symptoms of mercury poisoning.

We may classify, therefore, tubular nephritis, or nephrosis, into: acute tubular nephritis or nephrosis, and chronic tubular nephritis or nephrosis, both with or without amyloid deposit, and the special form of necrotic tubular nephritis or nephrosis, of which the sublimate kidney is the prominent example.

Of the affections of the vessels of the kidney we have mentioned arteriosclerosis of the finer vessels, the commonest kidney affection, and presenting the well-known syndrome of hypertension with a sufficient kidney. There is no loss of variability of function, no loss of concentration ability, no increase of rest nitrogen in the blood. The symptoms are mostly cardiac, due to the relative insufficiency of the hypertrophied heart as a result of prolonged hypertension. Prognosis is good. The patient may carry his hypertension for twenty years, with periodical cardiac decompensation, which responds promptly to rest in bed, a dry and salt-free diet and digitalis. Death is usually due to cerebral hemorrhage or some other affection.

Lastly we must consider the other form of kidney sclerosis in which there is an arteriosclerosis of the finer and finest vessels, including the vasa afferentia of the glomeruli. To this there is added a glomerulo-nephritis, not involving all the glomeruli but rather focal in type, not of bacterial origin, but of unknown etiology, probably the result of toxins produced in the body. Volhard and Fahr have termed this the combination form, or malignant hypertension. To the symptoms of hypertension there are added here the symptoms of nephritis and kidney insufficiency, a blood pressure of 200 and above, complete loss of variability of function, specific gravity of the urine, practically fixed,

of about 1006, a gradually increasing rest nitrogen level in the blood, with the final symptoms of true uremia. There are various arterial symptoms due to arterial changes in the brain and elsewhere. Albuminuric retinitis is an early manifestation.

Prognosis is always bad. This form of malignant sclerosis always leads to death as a result of kidney insufficiency.

With these two forms of kidney sclerosis, namely, the benign sclerosis of kidney vessels or benign hypertension, and the malignant form of kidney sclerosis or malignant hypertension or combination form, we have classified practically all the various forms of Bright's disease.

It is at once evident that the classification of Bright's disease in this manner, and a knowledge of the principles underlying their individual symptomatology, give us a better view of the prognosis and definite indications for treatment. For this we are indebted to the epoch-making work of Volhard and Fahr, a book that should be read by everyone interested in kidney disease.

AN EPIDEMIC OF DYSENTERY AT THE BOSTON STATE HOSPITAL, DUE TO A MEMBER OF THE PARATYPHOID-ENTERITIDIS GROUP.

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AND

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[From the Laboratory of the Boston State Hospital.]

(Concluded from page 220)

The results of the agglutination tests with both human and rabbit sera illustrate well the group reactions, but further than that, are very difficult, or even impossible, to evaluate, in view of the complexity of agglutination reactions within the group. The outstanding result is that the present organism is not an ordinary *A* or *B*. It does not react to any extent, either, with anti-enteritidis or antisuipestifer serum, although its immune serum agglutinates both organisms. The high reactions with *B*. enteritidis should probably be discounted to some extent because of the easy agglutinability of the strain.

As to the place of the present organism within the paratyphoid group, it is impossible to say anything more definite than that it is not an ordinary *A*, *B*. enteritidis or suipestifer, but that, according to agglutinative affinities, it resembles the three latter more than *A*. It does not fit well into either of the chief divisions of the group as outlined by Sobernheim and Seligmann.¹⁵ It might probably be considered as one of the *C* types.

IX. PATHOLOGY.

Autopsies were obtained on two cases in the spring epidemic of 1915, also on a patient who recovered from a severe attack and died five months later of other causes, and two cases of the milder form of the disease which prevailed in 1916.

The two acute virulent cases presented similar pathological pictures. The chief conditions found were: first, an acute fibrinous ileitis and colitis, from which an almost pure culture of the organism was obtained; second, a septicemia, the bacillus being isolated in pure culture from the heart's blood; third, cloudy swelling of the liver, with focal necroses in case 2; and fourth, a pneumonia of the septic type, with miliary abscesses and large areas of necrosis, from which the organism was recovered, associated with streptococci.

The intestine presented a striking appearance. The lesions began a short distance above the ileocaecal valve, involved the entire colon, and in the first case, the rectum also. The intestinal wall was thickened and covered with irregular patches of dirty yellow-gray exudate, interspersed with bright-red mucosa, frequently showing foci of hemorrhage. The membrane could be scraped off, leaving an eroded hemorrhagic surface. There were no ulcers and only very moderate swelling of Peyer's patches. The regional lymph-nodes were enlarged and injected. Microscopically the intestine showed a necrosis extending inward for varying distances, sometimes converting the entire mucosa into a fibrinous membrane. The latter had sloughed in various small areas, exposing the extremely edematous submucosa. The exudate was composed of lymphoid and plasma cells; polymorphonuclears where fibrin was present, and large phagocytic endothelial cells. The latter were present in some sections in considerable numbers but were not as abundant as in the intestinal lesions of typhoid fever.

The pneumonic exudate was characterized by phagocytic cells, similar to those in the intestine, but more numerous. Small numbers were also found in the mesenteric lymph-nodes, but none in the liver.

Condensed summaries of the protocols are as follows:

CASE 1. R. K. (A-15-23) aged 50. A much demented case of Korsakow's psychosis, in hospital two years. Died on fifth day of dysentery. Autopsy five hours post mortem. Body well built, well nourished. Body heat and rigor mortis present.

Ventral Section. Small amount of free fluid in pelvic cavity.

Thorax. Recent adhesions over posterior portions of each lung. No excess of fluid in pleural cavities.

Heart. Weight 300 gms. Valves normal. Myocardium somewhat friable and endocardium gray. The descending branches of both coronaries show occasional plaques.