Lecture.**THE DIFFERENTIAL DIAGNOSIS OF THE ACUTE EXANTHEMATA, WITH ESPECIAL REFERENCE TO SCARLET FEVER.¹**

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GENTLEMEN:—Your Professor of Diseases of Children, Dr. W. P. Northrup, has honored me so far as to ask me to open his course on the Exanthemata, and it gives me great pleasure to comply with his wishes.

What I tell you must necessarily, from the time which is given to this lecture, be limited to a few important facts concerning the exanthemata as a group, and to a few salient points concerning the most important of this group, scarlet fever.

In contradistinction to the various diseases of the skin which dermatologists are accustomed to designate as exanthems of local origin are certain acute, specific, infectious diseases which are called the exanthemata. The exanthemata occur most commonly among children, and are practically self-protective, the exceptions being when they develop in an individual more than once.

The exanthemata comprise five diseases, — variola

special, and of the differential diagnosis between the various members of this group you should understand that, though the efflorescence is important, it is not necessarily the essential or exclusive factor of the problem. Thus a papular efflorescence, although significant in most cases of measles, may also be present in other members of the group; while an erythema closely resembling scarlet fever may occur in variola, measles or rubella. You should, therefore, be familiar with the characteristics of all the stages of these diseases, as it is by a careful consideration of the pictures which they present to us as a whole that we avoid being misled by what may or may not occur in any one of the stages, and in fact thus only can be made a correct differential diagnosis in the atypical cases which at times confront us. It is the experience of those in charge of the contagious hospitals that patients supposed to have variola or scarlet fever, from the efflorescence which they present, are sent to the hospital, when no variola, but varicella exists; when no scarlet fever, but measles, or even diphtheria, exists. Again, since antitoxin injections have been used, a class of efflorescences has arisen, the result of such injections, which simulates so closely both scarlet fever and measles that we cannot distinguish them

	VARIOLA.	VARICELLA.	MEASLES.	RUBELLA.	SCARLET FEVER.
Incubation	12 days.	17 days.	10 days.	21 days.	4 days.
Prodromata	3 days.	A few hours.	3 days.	A few hours.	2 days.
Efflorescence	Macules. Papules. Vesicles. Pustules.	Vesicles.	Papules.	Papules.	Erythema.
Desquamation	Large crusts.	Small crusts.	Furfuraceous.		Lamellar.
Complications and sequelae . .	Larynx. Lungs.		Ear. Lung. Tuberculosis.		Kidney. Ear. Heart.

(small-pox), varicella (chicken-pox), measles (rubeola), rubella (German measles, röteln), and scarlet fever.

This group of diseases is characterized by certain conditions common to all. They run a definite course and are self-limited. Each member of the group is supposed to have its own special micro-organism which produces it, but none of these organisms have as yet been discovered. The course of all of these diseases from the time when infection takes place up to the appearance of their later manifestations may be divided into four distinct stages:

(1) The stage of incubation, during which the micro-organism has entered the individual and, so far as external manifestations are concerned, is lying dormant.

(2) The prodromal stage, when certain general symptoms appear, varying according to the characteristics of the special member of the group represented.

(3) The stage of efflorescence, during which an efflorescence appears on the skin.

(4) The stage of desquamation.

You will see by this table how the different stages vary according to the member of the group in which they occur. One of the first points to which I wish to call your attention is that in the recognition of a

from these diseases, and when, too, these cases are added to efflorescences arising from a number of drugs, such as belladonna, we are forced to admit that it is not safe in making a differential diagnosis between the acute exanthemata to depend on the character of the efflorescence.

Keeping this table before you, I will briefly refer to its contents.

The length of the stage of incubation in variola is about twelve days, in varicella about seventeen days, in measles about ten days, in rubella about twenty-one days, and in scarlet fever about four days.

The characteristic prodromata of typical cases of variola is three days in length, and in young infants is commonly represented by convulsions, restlessness, quick pulse and high temperature (104°, 105° or 106° F.). In varicella it is a few hours in length, and only shows slight malaise. In measles it is three days in length, with heightened temperature (101°, 102° or 103° F.), cough, coryza and lachrymation. In rubella it is only a few hours in length, with slightly heightened temperature and malaise; and in scarlet fever it is one or two days in length, and accompanied by apathy, nausea, vomiting, sore throat and high temperature (103°, 104° or 105° F.). Observe how different are these groups of symptoms in their prodromal stages, and how valuable they are for differential diagnosis.

¹ The Opening Lecture in the Course on Children, delivered by invitation of the faculty at the Bellevue Hospital Medical College, New York, December 16, 1896.

There is also a peculiar range of temperature characteristic of each disease. In variola, a rapid rise of temperature on the first day to 104° or 105° , and remaining at about this height to about the third day, with slight remissions in the morning, and a decided fall in temperature almost to the normal on the fourth day (this period being called the fever of invasion), then a slightly raised temperature on the fifth and sixth days, and a rise to 104° or 105° again on the seventh, eighth and ninth days (the fever of suppuration), and then falling by lysis to the normal at about the thirteenth or fourteenth day.

In varicella, a slight rise of temperature with the appearance of each successive group of vesicles, the temperature falling to the normal in a few days.

In measles, a sudden rise on the first day, then falling almost to the normal on the second day, and again rising on the third day as the efflorescence appears, remaining up for two or three days, and then on the fifth or sixth day dropping by crisis, or a broken crisis, and becoming normal on the seventh, eighth or ninth day.

In rubella, a slightly raised temperature lasting for a few days.

In scarlet fever, rising steadily for four or five days, and falling by lysis to the normal at about the tenth or eleventh day.

We now arrive at the stage of efflorescence, which in variola consists of macules, papules, vesicles and pustules, all developing one from the other in slow progression. In varicella, vesicles develop from macules and papules so rapidly that we speak of the lesion as essentially vesicular. In measles, papules. In rubella, papules; and in scarlet fever a punctate erythema.

Let us now for a moment observe the topography of the different members of the group. What is the geographical distribution on the skin characteristic of each of these diseases? Supposing that we make certain arbitrary divisions, the head, the neck, and the thorax, and observe in which of these areas the efflorescence is most apt to begin in the several diseases. This is a very important point, and is often of great aid in making the differential diagnosis of a doubtful case. Thus in variola the efflorescence is most apt to begin on the forehead; in varicella on the face, behind the ears, and on the back; in measles on the face; in rubella on the face and thorax, being rather irregular in its distribution; while in scarlet fever it first appears on the neck and thorax.

As illustrating the locality and appearance of these efflorescences, I will now show you first a case of varicella.

This little girl, after feeling sick for a few hours, presented this vesicular efflorescence on her face and back, which then quickly covered the whole body. You will notice that the face is not swollen.

This second case, a little girl six years old, you will notice has a papular efflorescence on her face, which is much swollen. It is a case of measles. The papules, as you see, have coalesced on the face, and the whole face has a blotchy appearance. This in connection with a few papules on the chest, some of them arranged in rather a concentric shape, and somewhat lighter in color than those on the face, complete the typical picture of the disease, measles, which you see in comparison with the next case which I shall show you, has an ugly and almost repulsive appearance.

This next case, on the contrary, which is one of scarlet fever, is an essentially becoming disease. The eyes are bright and clear, where those of measles were dull and reddened. The skin of the forehead and nose, and about the mouth is white and smooth in comparison with the rough, congested skin in the case of measles. This boy, as you see, presents the efflorescence of scarlet fever, a punctate erythema, markedly located on the neck and thorax, so that the mere location of the efflorescence would make us state at once that one was a case of measles and the other of scarlet fever.

As to the remaining points of differential diagnosis in the exanthemata, I have only time to state that the stage of desquamation shows in variola large crusts, in varicella small crusts, in measles a fine furfuraceous mealy condition of the skin. Rubella, as a rule, shows no desquamation; and in scarlet fever there is a lamellar desquamation often amounting to large strips of skin.

The complications and sequelæ of the different members of the group differ according to the disease. Those which are particularly to be thought of and apprehended are, in variola, an invasion of the larynx and the lungs; in varicella, nothing especial; in measles, the eye, the lung, and a tendency to general tuberculosis; in rubella nothing especial; and in scarlet fever the kidney, ear, and heart.

I shall now, gentlemen, occupy the remainder of the time allotted to me in speaking of certain important conditions connected with the disease scarlet fever. Scarlet fever is one of the group of exanthemata, and is characterized by a short incubation, a short prodromal stage, erythematous efflorescence, a pronounced desquamation, and a long course. The micro-organism which produces it has not yet been discovered. The streptococci which are so often found in this disease seem to be merely manifestations of a secondary infection, as they do in diphtheria. So far as infants and young children are concerned, scarlet fever is the most important of all the exanthemata. Not being controlled by vaccination, as is variola, it occurs far more frequently than does that disease. Its complications are so much more serious, and its sequelæ so much more common and grave than measles or varicella that a thorough knowledge of all its manifestations is exceedingly important to the physician whose practice is among children.

Scarlet fever is the most irregular of all the exanthemata in its virulence and in the manifestations which it presents in different individuals. The skin appears to be the chief vehicle of the contagium, which has a wonderful tenacity for clothing and other articles, and may be capable of reproducing the disease for many months. In contradistinction to measles, which is known to be highly infectious in the early stage, scarlet fever appears to be most infectious in the later stages, and the contagium to be most likely to be disseminated during the stage of desquamation. As illustrative of this fact, I will report to you the cases of two children who were under my care a few years ago.

A boy six years old and a girl four years old slept in the same room, with their beds touching each other. The boy was taken sick May 1st, but remained in the same room with his sister during that day and the following night. He was seen by me early on the morning of May 3d, and was then found to have scar-

let fever. His sister was taken to the country and the boy was left in charge of a trained nurse. There was absolutely no communication between the town-house and the country-house, either by people, clothes or letter. I myself did not again see the boy during his sickness, having placed him under the charge of another physician.

On June 1st, I was called to see the girl, and found that she had scarlet fever. There were no other cases of scarlet fever in the vicinity of the country-house where she had remained since leaving the city.

The boy at this time was desquamating freely, and four days previous to the girl's being taken sick a letter written by him had been sent to her, and she, after having had it read to her, had been allowed to keep it under her pillow.

A careful study of this case led to but one conclusion, that the boy during the period of his desquamation had infected his sister at a distance of twenty miles by enclosing the contagium of scarlet fever in an envelope. The girl, although she had been in the same room with the boy for thirty-six hours at the beginning of the disease, and although susceptible to the disease, had not contracted it at that time, owing to its very slightly infectious nature in its early stages. On the other hand, the incubative stage of scarlet fever being only a few days, and many instances having proved that the disease is very infectious during its period of desquamation, it was evident that the girl had been infected by means of the letter.

In the following year, on May 20th, I was again called to see the same boy. He had been well in the morning, but in the afternoon was found to have a high pulse and temperature, with coryza and lachrymation, so that it was deemed best to send the sister, who had been in the nursery only a few hours with her brother after he had been taken sick, to another house, while the boy was absolutely isolated. Three days later the boy was found to have measles. Ten days later the girl was attacked by measles. This case merely emphasizes the now commonly accepted belief that measles, in contradistinction to scarlet fever, is highly infectious in the early hours of the disease.

Scarlet fever may occur at all ages but the vulnerability to the disease is decidedly lessened after the tenth year. There is no drug which will prevent scarlet fever or cure it. It is a self-limited disease, and is apparently benign or malignant according to the vulnerability of the individual. Thus we may meet with many cases where the symptoms are so mild and the convalescence so rapid that the disease runs as uneventful a course as does the usual case of measles. Again, in the same family at the same time another child may be attacked with severe prodromal symptoms, convulsions, delirium, and later uremia, endocarditis, or purulent otitis media. These cases are not necessarily fatal but, rendered dangerous from the gravity of their sequelæ, may still be considered benign in comparison with a third class of cases, which also may arise in the same family with the benign cases, but which is so terrible in its manifestations and so universally fatal that it can well be called malignant.

Bearing in mind what I have just told you, you will, I know, agree with me that we should discountenance the opinion so often expressed by the laity, and too often supported by the physician, that it is well for children to have scarlet fever while they are young

and get through with it, on the ground that they may contract it at a later period of life when the type of the disease may be more severe. The assertion that the type of the disease is more severe in adults than in children is not corroborated by my experience. In either case it is probably the individual vulnerability which makes the disease benign or malignant, and we have no right to encourage the parents by our advice to take the risk and responsibility of testing whether the individual child happens to have or not a special vulnerability to the scarlet fever organism, and whether it will contract the infection and the benign or malignant form of the disease result. On the other hand, the sequelæ are far more dangerous and far-reaching in the child than in the adult. For instance, a large proportion of our deaf mutes have had their deaf-mutism originate in an otitis secondary to scarlet fever. The commonly occurring and often intractable form of otitis which accompanies scarlet fever may not only render the child deaf, but in a case where the child has not learned to talk, may lead to deaf-mutism.

There are, then, three distinct types of scarlet fever apparently caused by the same micro-organism, but determined by the vulnerability of the individual. The first benign and harmless; the second benign, but dangerous from its complications and sequelæ; and the third malignant. The first and third types can, after what I have told you, be described in a very few words.

In the first class, for instance, a child four years old, exposed to scarlet fever four days previously is on the fourth day attacked with vomiting, a reddened throat, a temperature of 104° F., and thirty-six hours later a punctate erythema appearing first on the neck and thorax and later extending to the arms, face and legs. No other symptoms arise during the course of the disease and the temperature falls slowly to the normal, as I have shown you when describing the comparative temperatures of this group of diseases. Desquamation of a lamellar character occurs in the second or third week. In these cases the urine is usually lessened during the height of the fever, gradually returns to the normal as the temperature falls, and during the stage of desquamation increases to such an extent as to almost represent a polyuria, this being a conservative effort of nature to restore the function of the kidney to the normal. In these cases the throat though reddened often does not cause sufficient discomfort to demand especial attention.

The differential diagnosis from measles in the prodromal stage by the appearance of the throat is as follows: In scarlet fever there is a general intense redness of the whole throat, including the hard palate. The entire mucous membrane is affected, and the small dots, which in connection with the hyperemic condition of the skin represents the condition of a punctate erythema from being localized on the moistened mucous membrane, have a little darker appearance than the adjacent reddened tissue. In measles, on the contrary, the mucous membrane of the throat has a blotchy appearance and is of a darker red than is seen in scarlet fever, while the mucous membrane between these blotches is but slightly congested in comparison with that of scarlet fever.

In these benign cases the diet should be entirely of milk, because in all cases of scarlet fever, even of the mildest character, there is in all probability a tendency

to nephritis, and if a nephritis develops, a diet of milk is the best treatment for the disease.

This first type of scarlet fever, therefore, is essentially benign, requires no drug treatment, and will do well with careful nursing, unless a nephritis is precipitated by injudicious diet or nursing.

The third or malignant type of cases can be described in still fewer words. We know of no treatment which is of the slightest avail in these cases. They all die. The streptococcus toxin in the future may be of some avail where the violence of the symptoms depends upon the secondary infection, but in all probability it is the primary micro-organism of scarlet fever which in this class of cases kills the child. Until this primary micro-organism has been discovered and its toxin produced, we shall probably never be able to cure the disease. It may perhaps impress this class of cases on your minds for me to describe a case which I saw some years ago in consultation.

A girl, eleven years old, was perfectly well and strong, and had no other diseases up to January 10th. In the middle of the day she felt very ill and vomited. Her pulse was 150, and her temperature was 104.5° F. The pharynx and tonsils were much reddened, but there was no exudation or membrane to be seen. An efflorescence of a scarlatinal type appeared on the chest in the afternoon. The vomiting continued through the night and up to the morning of January 11th. The child was conscious, but dull. The pulse was 150, and the temperature was 105° F. At 4 p. m. the face became puffy, and the efflorescence was well marked on the body and extended to the extremities. The child was wandering and stupid and the temperature rose to 108° F. The extremities became livid and the vomiting began again. At 6.30 p. m. the temperature, after the internal administration of various remedies, was found to be 107° F., and at 10 p. m. 106° F., and the pulse 160, weak, and difficult to count. At 6 a. m. on the 12th, forty-eight hours from the appearance of the first symptoms, the child died.

The case was a perfectly hopeless one from the beginning, as every method of treatment which could be thought of was tried and proved absolutely fruitless. Tub-bathing with water at different temperatures, and finally sponging with ice-water, had no effect whatever on the temperature or the general symptoms.

The second type of what I have called the benign cases of scarlet fever is of much interest and is well worthy of study. While there is no treatment by drugs for the first and third types, which I have just spoken of, and no known treatment of any kind which will cure the third, there is no class of diseases in children which needs more general treatment, including drugs, and gives more satisfactory results than this second class of cases. Children have such wonderful recuperative powers that even the seemingly desperate cases may recover, and organs apparently crippled be restored to a fair working capacity. As in every disease, a knowledge of the pathology is of primary importance if we expect to intelligently make the diagnosis and carry out the treatment, so in this more serious class of cases of the benign form of scarlet fever we should appreciate what organs are affected, and what morbid conditions are most likely to be met with.

The organs primarily affected in scarlet fever are the skin and the throat.

The principal complications which arise in the

course of the disease are connected with the ear and the cervical glands.

The chief sequela, and the only one which is at all common, is nephritis. Cardiac disease, commonly secondary to the nephritis, may occur. Lesions of the other organs are unusual, and have no direct connection with the scarlet fever. They are due partly to the fever and partly to the septic processes which have arisen in the course of the disease, and are represented, as would naturally be expected, by a congested condition of the various internal organs, and by the usual changes which are found in pleuritis, pericarditis, endocarditis and meningitis.

The Skin. — Macroscopically the morbid conditions of the skin in scarlet fever, though varying in their manifestations, are usually represented by an intense general erythema, covered thickly with minute macules which are of a darker red than the accompanying hyperemia. Minute white spots may also appear thickly scattered over the reddened surface, probably arising from areas of unaffected skin existing in the midst of the general hyperemia. No evidence of this hyperemic condition, which is so pronounced during life, is found after death.

According to Neumann, microscopic examinations of the skin explain in a measure why scarlet fever is so much more likely to be infectious during the stage of desquamation than is measles. In contradistinction to the pathological processes which are found in the skin in measles, and which affect chiefly the blood-vessels and glands, a very different picture is presented on examination of sections of skin taken from scarlet fever. In the latter we find the pathological process represented especially by exudative cells, which are very numerous and are closely packed together, reaching even up to the horny layer of the epidermis. Occasionally these exudative cells may finally take the place of the epidermal cells, appearing on the free surface of the skin, and are gathered thickly among the excretory ducts of the cutaneous follicles. You will thus readily understand why the tissue proper of the skin and its epidermis presents no marked changes in measles, and why the epidermal cells are far less likely to carry the contagium than in scarlet fever where the possibility of contagion exists until the desquamation has entirely ceased.

The Throat. — The earliest lesions of scarlet fever appear on the mucous membrane of the hard and the soft palate. This appearance is very similar to the efflorescence which is seen on the skin, except that the minute white spots do not appear on the congested mucous membrane. The pathological conditions which occur in the throat in scarlet fever may be either simply catarrhal or the result of one of the more severe inflammatory conditions affecting the tonsils, the pharynx and the larynx.

One of the most marked features of scarlet fever is the predisposition which it entails to the incursion of pathogenic germs other than those which we believe to cause this disease. Thus, in addition to the inflammatory lesions produced by the scarlet fever organism, an acute exudative inflammation of the mucous membrane apparently caused by the streptococcus pyogenes may be associated with them. We may conclude indeed that in scarlet fever the mucous membrane of the throat is rendered peculiarly vulnerable to the invasion of pathogenic germs, and that where the morbid condition in the throat is represented by a pseudo-mem-

brane it will be found in the great majority of cases that the process is due to streptococci. On the other hand, where diphtheria is prevalent and the opportunities are favorable for exposure, a large portion of the cases may be due to the Klebs-Löffler bacillus.

In addition to the lesions of the throat just described, the micro-organism of scarlet fever may attack the naso-pharynx. In this way also by direct extension through the Eustachian tubes secondary aural lesions may be produced. The morbid changes in the naso-pharynx which thus take place may result in a thickening of the tissues which in some cases lasts for many months after the fever has run its course.

The Ear.—The pathological condition of the ear which is most commonly met with in scarlet fever is an acute inflammation of the middle ear. This inflammation is likely to result in the destruction of tissue, the formation of adhesions, the establishment of a long-continued suppurative process, and an accompanying necrosis.

Cervical Glands.—There may be hyperplasia of the cervical lymph-nodes. This condition is sometimes accompanied by inflammatory edema of the tissues of the neck, which may go on to suppuration and even to gangrene. In these cases streptococci are found in the glands and in the areas of suppuration. The infection is supposed to originate in the throat. The enlarged glands are, as a rule, indicative of secondary or mixed infection though it is possible that the slighter forms of enlargement may be due to reflex irritation with resulting hyperplasia from the scarlet fever contagium. In the severe form the glands are at times very much enlarged, and where a gangrenous process results the blood-vessels may be affected to such an extent as to be ruptured.

The Kidney.—In scarlet fever, as in a number of other infectious diseases, there are certain poisons produced in the course of the disease which are probably soluble in character. The result of bacteriological cultures in scarlet fever have shown that in a number of cases there is a general streptococcus infection, the infection probably coming from the lesions in the pharynx. In these cases of general infection streptococci may be cultivated from most of the organs of the body, there being a general septicemia. In a number of these cases extensive lesions may be found in the kidneys and yet these lesions may bear no relation whatever to the presence or absence of streptococci. In like manner streptococci may be found in the kidney without any lesion of the kidney. These lesions are diffuse and affect both kidneys and all parts of the kidneys. From the best evidence which we have it would seem that the virus, or whatever it is which produces the lesions in the kidney, is not a living organism but is a soluble chemical poison produced by the organisms of scarlet fever, or by some other organism located in some other part of the body. This soluble poison when produced elsewhere is taken locally into the blood and affects various parts of the economy. In post-mortem examinations of scarlet fever certain lesions will be found in the kidney.

These lesions, according to Councilman, may be divided into two classes: (1) represented by simple degeneration of the epithelium, and (2) represented by marked changes in the tissues of the kidney.

In the first class of cases the soluble poison may only affect the integrity of the capsular epithelial cells of the glomeruli. The poison may produce cer-

tain degenerative changes in these, but need not be accompanied by any proliferation of cells or by any condition which may be characterized as inflammatory. It is more than probable that these simple degenerative lesions are accompanied during life by evidence of albuminuria, and in case death takes place there may be no macroscopic evidence of any lesion in the kidneys. Careful microscopic examination, however, will show a condition of degeneration in the capsular epithelium of the glomeruli. Associated with this there will usually be found cloudy swelling of various degrees of intensity in the cells of the convoluted and the smaller collecting tubules. The degeneration here is rarely of a fatty character. Clinically, in the purely degenerative changes there may be only albuminuria with the presence of faint hyaline casts and here and there a few leucocytes.

In the second class, owing to a greater intensity in the action of the poison, or to some possible difference in its character, more marked changes may take place in the kidney and may be accompanied by the degenerative lesions which are distinctive of the first class. Different forms of lesions may occur in the second class, and, according to the predominance of one form over the other, may characterize a special form of renal disease. Thus these lesions may be divided according to their anatomical distribution into interstitial, where there is a marked proliferation of the interstitial tissue, and glomerular, where the lesions are chiefly confined to the glomerulus and its capsule.

In the interstitial form there may be found in the interstitial tissue between the tubules accumulations of cells which are probably due to a proliferation of cells of the capsule and of the connective tissue. These cells are most of them epithelioid in character and show very few leucocytes mingled with them. This form of nephritis should be considered as purely interstitial, since its lesions are in no way related to those of the epithelial tissue. There is both a general and a focal infiltration of cells in the interstitial tissue. The focal infiltration is found principally in the cortex of the kidney and about the glomeruli, the glomerulus frequently appearing as a centre from which the infiltration extends into the interstitial tissue between it and the surrounding tubules.

Clinically, in this form there may be little evidence of the severity of the lesions. There may be, however, albuminuria corresponding to what is seen in the purely degenerative class. The quantity of the urine may be very little diminished, and casts may be present, as well as a certain number of desquamative epithelial cells and leucocytes.

These lesions are not confined to scarlet fever, but may be found in diphtheria, in measles, and in other infectious diseases of children. They are not common in the infectious diseases of adults.

The other form of nephritis, called the glomerular, is much more frequently found in scarlet fever than is the interstitial form and may be considered almost typical of the disease. In this glomerular form the chief lesion of the disease consists essentially in a proliferation of the capsular epithelium combined with hyperplasia of the connective tissue.

The proliferation of the capsular epithelium leads to the formation of masses of cells within the capsule between the glomerular capillaries and the capsule. These cells evidently result from the proliferation of

the capsular epithelium. As a result of this there may be greatly increased pressure on the vessels of the glomerulus with possibly obliteration of these vessels. The cellular infiltration of the interstitial tissue is not so extensive as in the other form. Accompanying these changes in the glomerulus there is almost always more or less hemorrhage both in the tubules and in the interstitial tissue.

It is this capsular glomerulo-nephritis which gives the most marked clinical evidences of the extent of the lesions in the kidney. In this form dropsy is almost always present, the amount of urine is greatly diminished, and in more severe cases there may be anuria. Blood-casts are found more frequently in the urine than in the interstitial form. The diminution in the amount of the urine points to the involvement of the glomerulus. Even severe cases of this form may be recovered from. In a certain number of cases from this form of nephritis a chronic nephritis is developed. These two forms of nephritis should be separated from each other, although transitions between their lesions are found. Usually they can be distinguished macroscopically.

We can, therefore, recognize three pathological conditions of the kidney in scarlet fever: first, the purely degenerative; second, the acute interstitial; and third, the capsular glomerular.

The Heart.—The pathological conditions of the heart which are at times found in scarlet fever do not differ in their macroscopic appearances from those met with in other diseases. Cardiac disease occurring in the course of scarlet fever may arise in two ways: (1) from the general septic condition existing during the period of the height of the temperature and general efflorescence, and represented usually by an endocarditis; (2) at a much later period from a nephritis which has arisen as a complication, and following which, from the resulting increased blood pressure, enlargement of the heart has been produced, which may be represented by hypertrophy, or by dilatation, or by both.

During the stage of efflorescence, especially if the temperature is considerably heightened, there may appear in the urine a small amount of albumin, but this disappears as the temperature subsides. It is probably only the result of the fever, as in many other diseases accompanied by a high temperature, and is not to be confounded with the albuminuria of the nephritis which in some cases complicates the stage of desquamation.

There is considerable reason to suppose that a mild form of nephritis accompanies almost every case of scarlet fever, although in many cases no clinical symptoms pointing towards the kidney appear and nothing abnormal is found on examination of the urine. This latter statement, however, rests to such a degree on the authority of the general practitioner, rather than on that of the expert in urinary analysis, that we shall probably in the future find the number of cases which show nothing abnormal in the urine greatly lessened when the number of expert examinations of the urine in mild cases of scarlet fever has increased.

In this second form of scarlet fever the gravity of the disease arises from the various complications and sequelæ, which may be of varying degrees of severity.

When the temperature remains heightened at the end of the period of efflorescence and continues into

the period of desquamation, especially if there is local pain anywhere, we should suspect that a nephritis may be developing. When the temperature after having become normal rises again we should expect such complications as otitis, and suppuration of the subcutaneous tissues of the neck or that the heart is involved. Certain cases are at times met with in which the high temperature, or the especial vulnerability of the child to the scarlet fever contagium, causes the symptoms to vary considerably from the typical form and be unusually grave.

As an instance of this class of cases I will report to you that of a boy six years old, seen in consultation with Dr. Loring. The invasion of the disease was characterized by restlessness and sore throat which were soon followed by vomiting and delirium. The temperature on the first day rose to 106° F. During the first three days the pulse could not be counted. The heightened temperature continued until the sixth day from the beginning of the prodromal symptoms. There was great gastro-enteric disturbance, and during the first forty-eight hours there was almost continuous vomiting. This was succeeded on the third day by frequent profuse, and often involuntary discharges from the bowels. These discharges continued until the fifth day. On the fourth day a slight erythematous efflorescence appeared on the neck and chest, and on the fifth day it extended all over the body and was of an intense character. On the sixth day pain in the wrists began but it disappeared in twenty-four hours under the administration of salicylic acid. At this time, also, there was considerable swelling on the left side of the neck which gradually disappeared in four or five days. When the fever was at its height there was considerable cyanosis, with quickened respiration. The pulse at this time was weak and difficult to count. Whenever the temperature reached 105° F. the child was placed on a pillow in the bath and kept there until the temperature was reduced three or four degrees. The time required to accomplish this was usually from one to one and a half hours. While the child was in the bath stimulants and milk were given to it. The temperature of the water was at first that of the child, and was gradually reduced to about 90° F. During the first four days the child was either delirious or in a comatose condition, and when in the bath would pass its urine and fecal discharges involuntarily. The high temperature continued until the sixth day when it fell and the baths were omitted: the temperature continued to fall by lysis until it reached the normal degree on the sixteenth day from the invasion of the disease. After this the child had no unusual symptoms and made a rapid recovery. There were no complications. The desquamation took the usual course.

Scarlet fever may begin with such great cerebral excitement as to lead us to suspect meningitis and it may not be possible to determine the diagnosis until the efflorescence has appeared, which may not be until even the eighth or ninth day.

Most of the complications which arise in scarlet fever are due probably to the action of streptococci, either isolated or associated with other micro-organisms. These micro-organisms produce serious symptoms, which are often followed by death, either directly by giving rise to septicemic processes or indirectly by nephritis.

It is supposed that the infection which complicates

scarlet fever enters the system commonly through the pharynx either by direct absorption or by inhalation of these organisms.

It is of great importance to detect by means of frequent analyses of the urine the beginning of either the milder forms of renal disturbance or the more severe forms of nephritis, usually represented by that which is called capsular glomerulo-nephritis. If carefully watched for, the appearance of albumin will almost always precede the clinical symptoms. It is quite frequently the case that a suspicion is first aroused as to the presence of nephritis, either by vomiting or edema of the face, especially about the eyes, commonly occurring during the period of desquamation, from the eighteenth to the twenty-fourth day. Under these circumstances the urine will be found to be diminished in quantity and to contain albumin. The daily amount of the urine may be reduced as low as three and one-half ounces or even lower. The microscopic examination of the urine does not materially differ from that which results from the other forms of nephritis in their early stages, but later you may find that fatty casts are less numerous in the nephritis of scarlet fever because there is less fatty degeneration in the renal epithelium. The earlier in the course of the disease the symptoms of nephritis appear, the more severe, as a rule, will be its type. The extent of the albuminuria is of less consequence than the total quantity of the urine. A rapid and extensive diminution of the urine is ominous, as it indicates the accumulation of nitrogenous waste in the blood and the danger of a resulting uremia. The albumin occurring early in the disease is more apt to be in large quantities than when it appears first in the third or fourth week. Hematuria is frequently present in this form of nephritis but ordinarily of itself adds little to the gravity of the disease. The edema of the face may be followed by a rapid involvement of the ankles and legs, and at times may become general. During the course of a general edema the desquamation is apt to cease, returning on its disappearance. The edema may last for months or may pass away quickly; it may be entirely absent, but in such cases the nephritis is almost invariably of a light grade.

At times during the presence of a general edema serous effusions into the pleura may occur. Edema of the lungs and brain, though very rare, may also take place. Instead of a slow development beginning with edema of the face, we may have an acute attack, ushered in by fever, vomiting, headache, edema, amblyopia, coma and convulsions.

Relapses may occur many weeks after an attack of scarlatinal nephritis, and we should watch the case with the greatest care for several months. The nephritis of scarlet fever, although it may last for months, has a tendency in children ultimately to recover, on account of their wonderful recuperative powers. It is also rare for the renal disease following scarlet fever to become chronic.

Retinitis and amaurosis at times occur during the progress of the nephritis in scarlet fever. In these cases of amaurosis it has been noticed that, although the loss of sight may be complete, almost always where uremia and amaurosis are coincident, there is found no perceptible change in the retina, no congestion of the papilla, no increase of intracranial pressure, and no intense edema of the brain. The sight under these circumstances may be recovered completely.

We find in quite a number of cases of capsular glomerulo-nephritis a rapid hypertrophy of the left ventricle. This cardiac complication is not to be confounded with the endocarditis which I have already spoken of as secondary to the scarlet fever, and which is supposed to be caused by its special poison or by the streptococci which I have already described as being present in the disease. It is, in fact, not the direct result of the scarlet fever, but is secondary to the nephritis, and is, in this sense, tertiary to the scarlet fever. We, therefore, do not find this acute cardiac hypertrophy in the earlier stages of scarlet fever; but when a capsular glomerulo-nephritis is once established, it may take place in so short a period as a week. This rapid hypertrophy has usually been observed in children between the ages of three and six years. At this age a physiological hypertrophy of the heart exists, possibly caused by a continuance of the aortic narrowing in the neighborhood of the ductus arteriosus, and the heart will thus be more readily affected by increased blood pressure. Besides the cardiac hypertrophy, we may at times have an acute dilatation of the heart in these cases. This is a serious condition, which must be guarded against, and when it occurs must be recognized at once. These various complications very frequently recover completely, as it is seldom that any extensive changes in the muscles of the heart take place.

We should be careful about using diuretics which might irritate the kidney. Acetate of potash is one of the safer diuretics in this complication. In severe cases, with general edema and threatening uremia, cathartics are rather more certain in their action than diaphoretics and diuretics, and are especially indicated where, as is usually the case, constipation is present. Podophyllin in doses of one-tenth of a grain may be given to a child five years old, and be repeated a number of times. It usually acts quickly. The compound jalap powder, in doses of five to ten grains, may also be given where a rapid and decided derivation by the intestine is indicated.

Having provided for the proper movement of the bowels, if the skin is hot and dry and uremic symptoms (usually represented by anuria, somnolence, amblyopia and headache) are present, the hot pack, either wet or dry, should be resorted to. I prefer in these cases to have the child wrapped in a blanket and placed directly in a tub containing water at a temperature of 105° to 110° F. The child should be kept in the water fifteen or twenty minutes, or even longer if necessary, and should then be taken from the wet blanket, enveloped in hot, dry blankets, and kept in them until the skin has become moist and reaction has taken place. While the child is in the bath milk can be given to it, and stimulants if they are indicated by a weak or an intermittent pulse.

In addition to this treatment, muriate of pilocarpine in doses of one-twentieth of a grain should be given by the mouth to a child of two years, and subcutaneously if desired to a child five years of age. In these cases of threatened uremia convulsions sometimes appear quite suddenly. Under these circumstances enemata of hydrate of chloral, five to ten grains dissolved in water, are of value in controlling the nervous phenomena. I prefer, however, to use a combination of bromide of potash and hydrate of chloral.

Where the ascites is extreme, paracentesis abdominis is often of great value, not only in relieving the press-

ure, but also in increasing the action of the diuretic which perhaps before was not acting freely. Digitalis is a valuable remedy especially adapted to the treatment of the nephritis of scarlet fever and to that of the cardiac changes which result from it. By the administration of this drug the flow of urine is increased. It is best given in the form of a freshly prepared infusion, in teaspoonful doses every four hours, to a child five years old. Diuretin, five grains dissolved in water and given two or three times in the twenty-four hours, has proved of considerable value in my cases, and is apparently harmless.

I speak of special ages, such as five years or two years, merely as a guide by which you can judge what the proper doses should be at the other ages.

I have not time to dwell upon the various other complications of scarlet fever, such as the acute inflammation of the joints and synovitis. I must, however, before ending this lecture impress upon you the importance of prophylaxis in the treatment of cases of scarlet fever where as complete an isolation as possible should always be enforced and where the diet should be as nearly one of milk as the case will permit. The remaining details of the treatment of scarlet fever I shall leave for Professor Northrup to give you in his coming lectures on this subject.

As illustrative of the benign type of scarlet fever, with complications, I will report to you the case of this boy, seven years old, who is said to have been well until eighteen months ago, when he had an attack of scarlet fever, mild in form and not accompanied by severe symptoms. In the latter part of the attack his temperature rose, and he began to have dyspnea and dropsy. Since that time he has been slowly but steadily growing worse. As you see, he has extensive edema of the face, chest, arms, abdomen and legs. He is somewhat cyanotic, and his breathing is so much affected that he is unable to lie down, the orthopnea compelling him to be supported in a semi-recumbent position. On closer examination you see there is slight puffiness about both eyes, that there is a yellow tinge to the conjunctivæ, and that the lips and tongue are cyanotic. The extremities are cold to the touch and their skin pits readily on pressure. The skin of the whole face is dry and harsh and in some portions is covered with fine scales. In addition to the edematous condition of the walls of the abdomen, a distinct fluctuation is found on palpation, showing that there is fluid in the abdominal cavity. An examination of the lungs shows that there is dulness over both bases behind; and over these areas, as well as over the whole front of the chest, fine moist râles can be heard, indicating an edematous condition of the lungs. On examining the heart I find that its impulse is most distinct in the sixth interspace a little outside of the mammary line. The area of cardiac dulness extends from the second rib on the left to one inch to the right of the sternum, in an area corresponding to the third interspace and fourth rib. The dulness then extends to the left, across the sternum, to a point one inch outside of the mammary line and as low as the sixth interspace, corresponding to the cardiac impulse. A loud systolic murmur can be heard over the region of the cardiac impulse, and is transmitted so that it can be heard in every part of the thorax. The total amount of urine in twenty-four hours has varied from 30 to 35 ounces. An analysis of the urine gives the following results:

Color	darker than normal.
Specific gravity	1.013.
Reaction	acid.
Urophæin	diminished.
Indican	increased.
Chlorides	diminished.
Albumin	four-tenths per cent.
Sugar	absent.
Sediment : very slight and flocculent.	

Microscopic examination shows numerous short hyaline casts, and granular casts; an excess of renal epithelium; considerable abnormal blood; an occasional white corpuscle; one or two blood-casts; many hyaline and granular casts with one or more renal cells adherent; occasional fatty renal cells and casts with a few fat drops adherent.

You see that he is unable to lie down with comfort on account of the dyspnea arising from the accumulation of fluid in the stomach. The cyanosis is so marked and the child is in so much distress that it is evident immediate relief should be given, not only to the general symptoms, but also to the great tax which is being imposed upon the already disabled heart. Unless some relief to these symptoms is given, it is very likely that he will die suddenly from heart-failure. I shall, therefore, withdraw a certain amount of fluid from the abdominal cavity, which will, I think, be followed by considerable relief to the dyspnea.

This case illustrates some of the points in the pathology and clinical symptoms of scarlet fever to which I have already referred. Of course in so late a stage of the disease as this it would be impossible to make a definite diagnosis as to the condition of the kidney and heart. It is possible that during the stage of efflorescence an endocarditis such as might complicate the earlier symptoms of scarlet fever may have been present, and may have been followed by a pathological lesion of the valves. The history of the case, however, shows that the course of the scarlet fever was a mild one, and that whatever complications followed arose at a later stage of the disease during desquamation. It would seem probable, therefore, that the symptoms of edema and cyanosis which appeared in this later stage of the disease were caused by a disturbance of the kidney. As I have already told you a renal complication is most common in the later stages of scarlet fever. The physical examination shows that there is a complication of the heart represented by cardiac dulness and a mitral systolic murmur. The examination of the urine shows us that it is probable that there are organic changes in the kidney as well as in the heart, although we cannot say definitely that such conditions as we find in the urine have not been produced by a cardiac lesion followed by passive congestion of the kidney. Therefore, although we cannot decide without a post-mortem examination whether both kidney and heart are affected, we can at least suppose that the following sequence of complications has resulted and has produced the present clinical symptoms.

The child had scarlet fever in a mild and apparently uncomplicated form until it reached the stage of desquamation. During the latter part of this stage a lesion of the kidney, presumably of the capsular glomerular form, occurred, and owing to the increased blood-pressure which finally resulted from the changes in the kidney, hypertrophy of the heart, presumably followed by dilatation, appeared. If I have correctly read this sequence of lesions, we have, then, cardiac enlargement secondary to renal disease and tertiary to the original scarlet fever contagium.

The prognosis in this case is very unfavorable. Although we know that in children dilatation of the heart may be entirely recovered from, yet as long as this condition exists there is danger of sudden death from cardiac failure. Where the cardiac dilatation results from extensive disease of the kidney, especially in the form which we most commonly meet with in scarlet fever, capsular glomerulo-nephritis, the chances are that this failure will take place before the nephritis has been recovered from, when a patient has been reduced to such a degree as is the case with this boy.

The treatment should be absolute rest so as not to tax the muscles of the heart more than can possibly be avoided. To relieve the intra-abdominal pressure, which augments the edema of the lungs and interferes with the action of the heart, paracentesis of the abdomen should be performed, as I have just told you. Hot baths should be given to increase the action of the skin, laxatives to relieve the congested condition of the kidneys, and non-irritating diuretics, such as acetate of potash and digitalis, are indicated. Nitroglycerine is valuable where the action of the heart at any time becomes suddenly feeble and irregular.

Original Article.

GAVAGE IN INFANTS.

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THE attention of the profession was called long since to the value of tube feeding in patients (infant or adult) suffering with forms of disease attended by obstruction to the passage of food into the stomach; but it is perhaps not so generally recognized that there are frequently, among infant patients, cases free from such obstruction in which resort to this procedure will be followed by gratifying results.

When a child *can* but will not swallow its food, we are apt to accept the condition as a decree of nature and console ourselves with the belief that the patient is better after all without the food. That such refusal is, however, not rarely the result of some slight discomfort attending the taking of food, or of a whim caused by the disordered *morale* of the child, and not dependent on a seriously disabled condition of the digestive organs, is certainly indicated by the few cases here reported in support of such assertion.

In other words, the infant, like the adult, often has in its morbid conditions of body or mind a positive distaste for nourishment of any kind; but, unlike the adult, is not able to call to its aid the power of will so often essential for the obedient execution of the physician's mandates. It is obviously our duty, then, in appropriate cases, to feed him if need be directly against his will.

Let no one imagine that I am thus advocating wholesale and indiscriminate "forced-feeding" of sick children, or asking anybody to disregard the evident indications of a given case: the point simply being, not to disregard the possibility of satisfactory assimilation of much-needed nourishment in spite of obstinate refusal to receive such nourishment in the ordinary manner.

Furthermore, the method not only offers the advantage of administering food of fixed amount and definite

proportions at appropriately regulated intervals, but also furnishes a ready means of exhibiting, at the same time, such medicine as may be desirable.

The indications for instituting this method of feeding need no extensive mention, but the following three selected cases from the wards of the Summer Hospital at Rainsford Island, certainly show that it has a varied application.

CASE I was a male infant, eleven months old, who had previously been under treatment for congenital syphilis in the wards and out-patient department of the Infants' Hospital. He had been lost sight of for some months, but in the latter part of July was sent to Rainsford with the history of ten to twelve dejections daily, and of taking his food badly. It was further elicited that the inunction cure had been persisted in without medical supervision for four months.

The physical examination showed nothing of material interest except general delayed development. He was fairly well nourished. After admission to the wards and cessation of the inunctions there was no diarrhea; but he persistently refused to take a satisfactory quantity of food, and consequently as persistently lost weight (seven ounces in five days). He was accordingly discharged with the idea that he would probably take his food better in the home surroundings.

To quiet a possible suggestion that it may have been the taste of the food that caused him to rebel, it should be noted that, although at first he was given a Pasteurized modification, this was later changed to non-Pasteurized whole milk, without effect.

Ten days after discharge he re-appeared, and according to accounts had been vomiting and defecating almost constantly since going home. It was found that he had continued to lose weight at the rate of nine ounces in ten days, and now, at the age of eleven and a half months weighed 12 pounds 11 ounces.

The diarrhea proved not to be an important factor in his condition, but he at once resumed his old tactics of refusing food, and on the fourth day had dropped to a total food consumption of 20 ounces daily (the normal average being about 40 ounces), with a loss in weight of six ounces. During all this time he seemed perfectly well and happy but simply would not take his food.

He was then put on alternate feedings by tube, with the immediate effect of raising his total for the following twenty-four hours to 32 ounces. For the next month, by aid of the supplementary feedings, he maintained a daily average of 34 ounces; and in this time, his weight, which had steadily fallen for at least three weeks previous to beginning the treatment, increased one pound.

The day before his discharge tube feedings were entirely omitted, and the total amount of food taken fell from 32½ ounces to 21½ ounces, and his weight dropped 1½ ounces. But as cool weather came on, he began to take his food better; and I have lately learned that he is now thriving.

CASE II was a male infant, four months old, who entered the hospital with fermental diarrhea complicated by a moderate degree of colitis. The treatment of the latter condition proved somewhat prolonged and does not concern us now. The important consideration was to get him to take nourishment enough to keep from falling seriously behind in vitality; for in the first 17 days he averaged only 14 ounces daily, when he should have taken about 30 ounces, and his weight dropped from 10 pounds 1½ ounces to 8 pounds 9½ ounces, a loss of 1½ pounds.

He was accordingly put on alternate feedings by tube, which brought his total for the next twenty-four hours to 20½ ounces (from 14 ounces), with an immediate gain in weight of 2½ ounces.

For the ensuing 26 days, that is, the period of supplementary feedings, his daily average was 27 ounces as against 14 ounces, and his total gain in weight one pound one ounce.

The intestinal disorder having yielded to treatment, tube