ON THE

DISEASES OF THE KIDNEY,

THEIR

PATHOLOGY, DIAGNOSIS, AND TREATMENT;

WITH

AN INTRODUCTORY CHAPTER

ON THE

ANATOMY AND PHYSIOLOGY OF THE KIDNEY.

BY

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TO

ROBERT BENTLEY TODD, M.D., F.R.S.

&c. &c. &c.

THIS VOLUME IS DEDICATED,

IN GRATEFUL ACKNOWLEDGMENT OF BENEFITS

DERIVED FROM HIS TEACHING,

AND OF MUCH VALUABLE COUNSEL, ENCOURAGEMENT,

AND ASSISTANCE,

BY HIS FRIEND AND FORMER PUPIL,

THE AUTHOR.

the kidney, and on the relation of this form of disease to fatty degeneration, formed the substance of one of the Gulstonian Lectures, which I had the honour of delivering at the College of Physicians during the Spring of the present year, and which have been published in the *Medical Times and Gazette.*

The volume will be found to contain some proofs and illustrations of the important principle,—that disease does not imply unmixed disorder, but that, amidst all the apparent confusion and contradiction occasioned by a lapse from the state of perfect health, there are manifest evidences of beneficent design, and a continual effort towards restoration. Without a constant recognition of this principle, true pathological science and the rational treatment of disease are alike impossible.

The study of renal diagnosis will, it is hoped, be much facilitated by the figures of the various forms of tube-casts, for which, as well as for the other wood-cut illustrations, I am indebted to Dr. Westmacott.

I have endeavoured to give my work, as much as possible, a practical tendency, remembering that the true end of pathology is the prevention and cure of disease; and while I am fully sensible of the imperfections of this treatise, I trust that my efforts have neither been misdirected nor entirely unsuccessful.

I am under obligation to a numerous list of friends; to my esteemed hospital colleagues, for permission to make unrestrained use of their cases; to others, who have supplied me with many specimens of morbid urine and kidneys—both very essential for the successful study of renal pathology: and my thanks are particularly due to my friends Dr. Hyde Salter and Dr. Lionel Beale, for valuable assistance, which they have afforded me in various ways.

G. J.

Woburn Square,
June, 1852.

TABLE OF CONTENTS.

CHAPTER I.

The Anatomy and Physiology of the Kidney.

CHAPTER II.

The Causes of Renal Disease.

Chapter III.

Acute Desquamative Nephritis.

Chapter IV.

Chronic Desquamative Nephritis.

CHAPTER V.

Waxy Degeneration of the Kidney.

CHAPTER VI.

Non-desquamative Disease of the Kidney.

CHAPTER VII.

Fatty Degeneration of the Kidney.

CHAPTER VIII.

Suppurative Nephritis.

CHAPTER IX.

Tubercular or Scrofulous Disease of the Kidney.

CHAPTER X.

Cancer of the Kidney.

CHAPTER XI.

Hæmaturia.

LIST OF ILLUSTRATIONS.

All the microscopic specimens are magnified 200 *times, except when it is otherwise stated.*

LIST OF CASES.

A glance at this list will render it easy to find any case which is referred to, by its number, in the text.

flat, and rests upon the muscles and fasciæ. The two kidneys are occasionally, but very rarely, united by a band of renal substance extending across the spine in front of the aorta. The two glands thus united have the form of a horse-shoe, the concavity of which is directed upwards.

Dimensions.—The average length of the kidney is from 4 inches to 4½ inches, its breadth 2 inches, and its thickness rather more than 1 inch.

Weight.—The average weight of the kidney is about 4½ ounces in the male, and somewhat less in the female.* The two kidneys are seldom of equal weight, the left being generally heavier than the right.

Relations. — The *anterior surface* of each kidney looks somewhat outwards, and is partly covered by the peritoneum. The right kidney has in front of it the ascending colon, and the left is covered by the descending colon. The anterior surface of the right kidney is also in contact with a small portion of the duodenum, and is covered by the right lobe of the liver. The anterior surface of the left kidney, at its upper part, lies in contact with the spleen, and is

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* The average weight of the kidneys has been variously estimated by different observers. (See Dr. Quain's *Anatomy,* 5th ed. p. 1187.) Dr. John Reid's observations (*Physiological, Anatomical, and Pathological Researches,* p. 386) indicate an average of rather more than 5½ ounces in the male, and nearly 5 ounces in the female. I believe that this high average is the result of estimating as healthy, specimens which may present to the unaided eye scarcely any indications of disease, but the weight of which has been much increased by the tubes being crowded with epithelial cells, the result of 'desquamative disease.'—(See Chap. iii.)

covered by the great end of the stomach, when this viscus is distended.

With reference to diagnosis, it is important to bear in mind the proximity of the kidneys to the colon, and the possibility of disease extending from one organ to the other. Abscess of the kidney has, in many instances, been known to burst into the colon, and it is not improbable that ulceration of the colon, either simple or malignant, might extend backwards into the kidney.

The *posterior surface* of the kidney is directed somewhat inwards; it rests upon the quadratus lumborum muscle, from which it is separated by the anterior division of the transversalis tendon; it is also in contact with the diaphragm, which separates it from the two or three last ribs; and with the psoas muscle, which separates it from the spine.

From a consideration of these relations, it will be seen that exploration of the kidney, with a view to detect enlargement or tenderness, may best be made immediately beneath the ribs in the lumbar region on either side of the spine. It will also be seen, that abscess originating in the kidney may extend backwards, and become diffused amongst the muscles in this region, or that it may approach the surface and discharge itself by an opening in the loins. Cases of this kind are known to occur, and when renal calculi have been the exciting cause of the suppuration, these have escaped through the same opening in the lumbar region.

The *circumference* of the kidney presents, 1st, an external border, thick, convex, semi-elliptical, and directed outwards, backwards, and upwards; 2nd, an internal border, directed inwards, forwards, and downwards, and presenting about its middle a deep notch or fissure, the *hilum*, as it is sometimes called. This notch is more marked posteriorly, where it corresponds to the commencement of the ureter and the pelvis of the kidney, than anteriorly, where it corresponds to the renal vein. The notch usually contains some adipose tissue, which passes in with the bloodvessels, and occupies the space between the substance of the kidney and the pelvis.

Of the *extremities* of the kidney, the superior, as before stated, is larger than the inferior, and directed somewhat inwards. It is immediately covered by the supra-renal capsule. The liver is above the right and the spleen above the left. The inferior extremity is directed somewhat outwards, and has below it, but at some distance from it, the crest of the ilium.

Ureter.—The *ureter* or *excretory duct* extends from the pelvis of the kidney to the bladder. It is a cylindrical canal, of a bluish white colour, varying in size from that of a crow-quill to that of a goose-quill. It is dilated and funnel-shaped above, where it is continuous with the pelvis, narrower in the middle part of its course, and again slightly dilated before its entrance into the bladder. The narrowest part of the tube is that contained in the walls of the bladder.

Each ureter passes, at first, obliquely downwards and inwards into the cavity of the pelvis, and then turns downwards, forwards, and inwards, to reach the side and base of the bladder. In this course its relations are the following:—In the hilum of the kidney the ureter lies behind the renal bloodvessels. From the pelvis of the kidney to the base of the sacrum it is in contact with the anterior border of the psoas muscle; it is covered by the peritoneum, and is crossed obliquely by the spermatic vessels. The right ureter has the inferior vena cava on its inner side; on a level with the base of the sacrum, each ureter crosses the common iliac, and below this the external iliac artery and vein, it passes behind the termination of the ileum on the right side, and the sigmoid flexure of the colon on the left. In the pelvis the ureter lies in contact with the wall of this cavity, being covered by the peritoneum, and crossing successively the obliterated hypogastric artery, the obturator vessels, the vas deferens in the male, and superior and lateral part of the vagina in the female. In that part of its course which is included in the wall of the bladder, the ureter is very close upon the neck of the uterus, and is thus liable to become involved in cancerous disease of that organ. That part of the ureter which lies in contact with the anterior border of the psoas, may become affected by disease extending from the substance of the muscle. The pathological museum of King's College contains a preparation in which an abscess, occupying the substance of the psoas muscle, has opened into the cavity of the ureter.

Bloodvessels.—The *emulgent* or *renal arteries* are the largest branches of the abdominal aorta, from which they proceed at nearly a right angle. Their origin is about half an inch below the superior mesenteric artery, the right being frequently somewhat lower and longer than the left. Each renal artery passes obliquely downwards, backwards, and outwards, towards the hilum of the kidney, giving off, in its course, branches to the supra-renal capsule, to the ureter, and to the surrounding areolar tissue.

At the pelvis of the kidney the artery usually lies between the vein and the ureter, the former being in front of, and the latter behind, the artery. In the hilum of the kidney, where the artery is surrounded by reticular and adipose tissue, it breaks up into four or five branches, and these again subdivide into smaller branches, most of which pass in front of the pelvis of the kidney, while a smaller number pass behind this part. Their course and distribution in the substance of the kidney will be described in a subsequent part of this chapter.

The right renal artery is covered at first by the vena cava, and then by its corresponding vein; the duodenum and pancreas are also in front of it. It crosses the spine and the right psoas muscle. The artery on the left side is covered by its corresponding vein, and crosses the left psoas muscle.

The *emulgent* or *renal vein* commences in the substance of the kidney by numerous minute branches, which unite into four or five trunks; and these again unite to form a single vessel, either in the fissure of the kidney, or at a short distance from this point. The vein passes almost transversely inwards to the vena cava, the right vein being shorter than the left on account of the position of the vena cava to the right of the spine. The vena cava presents a marked increase of size immediately after receiving the renal veins. Each renal vein is placed in front of the corresponding artery; the vein on the left side crosses over the aorta. The renal veins receive some small branches from the supra-renal capsule, and from the areolar and adipose tissue surrounding the kidney, and the left renal vein is usually joined by the spermatic of the same side.

The *lymphatics* of the kidney are but little known; they are said to consist of a superficial and a deep set, the latter being the most abundant; they pass from the fissure of the kidney to the lymphatic glands which surround the aorta and the vena cava.

The *nerves* of the kidney are very numerous, consisting of several small branches from the lower and outer parts of the semilunar ganglion and solar plexus, joined by the descending branches of the small splanchnic nerve. The renal plexus, thus constituted, accompanies the branches of the artery into the fissure of the kidney. This plexus sends numerous filaments to the spermatic plexus, and hence, probably, the sympathetic connexion which exists between the testicle and the kidney.

STRUCTURE OF THE KIDNEY.

General Structure.—In order to examine the general structure of the kidney, it is necessary to make a longitudinal section from the convex towards the concave border. On examining the surface of such a section, it will be seen that the substance of the kidney is composed of two portions, differing from each other in their general appearance and structure; an external *cortical*, and an internal *medullary substance*. It will also be seen that the entire organ is invested by a *fibrous capsule*, which, at the hilum, becomes continuous with the pelvis of the kidney and with the ureter. It will be better to describe the general appearance and structure of these several parts before proceeding to the consideration of their minute anatomy.

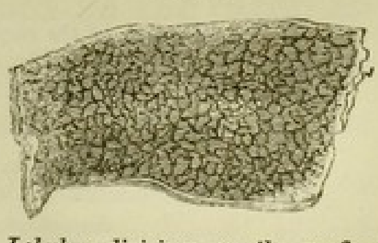
The *cortical substance* forms a layer about two lines in thickness, which occupies the surface of the kidney, and sends inwards prolongations from one to three lines in thickness, between the conical divisions of the medullary substance. The colour of the cortical substance is much influenced by the quantity of blood which it contains. It is usually of a lightish red colour; but in anæmic subjects it frequently presents a yellowish-white appearance, this being the colour of the renal tissue when deprived of blood. The cortical substance is of a softish consistence, readily tearing beneath the pressure of the finger, and then presenting an irregular, slightly granular surface. In an injected specimen there may be seen scattered through the cortical substance, in every part except near the surface of the organ, numerous minute red granules; the bodies have been named, after the distinguished anatomist who discovered them, the *Malpighian bodies* of the kidney.

The great mass of the cortical substance is made up of secreting tubules, the existence of which was first clearly demonstrated by Ferrein; hence they have been named the *tubes of Ferrein*.

The course of these tubes being for the most part very tortuous, they are often called the *convoluted uriniferous tubes;* but near the bases of, what will presently be described as, the pyramids of Malpighi, there is an appearance, visible even to the naked eye, of straight lines radiating towards the surface of the kidney; these lines are formed by bundles of tubes passing outwards from the pyramids, and retaining an almost straight course until they reach the capsular surface of the organ, where they become tortuous and pass backwards deeply into the cortical substance.

The capsular surface of the cortical substance presents an appearance of *lobules* somewhat similar to those of the liver. The form of these lobules varies considerably; in some instances they are circular, but very commonly they have a pentagonal or hexagonal outline. They are usually about one-eighth of an inch in diameter. This lobulated appearance of the surface is produced by the venous radicles which are dispersed at nearly equal distances throughout the cortical substance, each receiving the blood, as will presently be shown, from the capillary plexus surrounding the convoluted tubes. These radicles unite in an irregularly arborescent figure, and form the several branches of the renal vein. Those on the surface have a tendency to converge

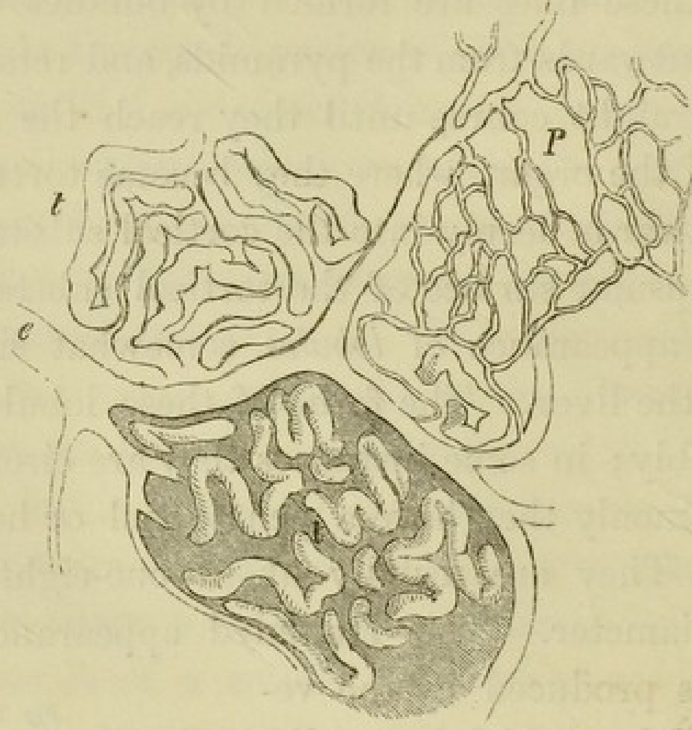
Fig. 1.



Lobular divisions on the surface of the Kidney, formed by the radicles of the emulgent vein.—Natural size.

towards a central vessel, which then dips into the interior to join the trunks of the renal vein. Thus are formed the *stellate vessels*, which are often very conspicuous in diseased specimens, when there has been an impeded circulation through the veins of the kidney. Between the arms of these stellæ the convoluted tubes are visible on the surface. Ferrein

Fig. 2.



Portion of the surface of the Human Kidney, injected from the Artery. The injection has burst some of the Malpighian tufts, and so filled the tubes.

t, t. Tubes.
p. Capillary plexus surrounding the tubes.
e. Branch of one of the stelliform veins, magnified 45 diameters.—BOWMAN.

supposed each of these lobules to form the base of a pyramid, the apex of the same being at the extremity of a mamillary process, and he believed that such an elongated pyramid might be traced continuously from one part to the other, the tissues radiating, as he imagined, from a point in the mamillary process, through the cortical substance, to one of the lobular divisions on the capsular surface. Mr. Bowman's preparations show that 'each lobule contains many tortuous ducts with their capillaries, but the convolutions of any one duct are not confined to a single lobule.' Hence it is manifest that there is no natural division of the renal substance corresponding with the so-called *pyramids of Ferrein*, and there appears no reason for retaining a name which is not expressive of an actual fact, but which rather suggests an erroneous idea of the structures in question.

The lobular appearance of the capsular surface of the kidney is very quickly changed by most forms of disease affecting the organ. Some of the vessels, which form the outline of the lobules, become obliterated, while others are dilated, the surface of the kidney becoming, at the same time, irregularly granular or nodulated. A smooth, lobulated capsular surface is, therefore, an indication that the kidney has not been the seat of long-continued or extensive disease.

In addition to the lobular divisions on the capsular surface there may sometimes be seen in the human kidney an appearance of larger divisions into *lobes*. This appearance is explained by referring to the condition of the kidney in the embryo. In the embryo of all mammalia, including, of course, the human fœtus, the kidney is composed of separate lobes or renules. The entire kidney is invested by a cellular capsule, a deep layer of which passes into the fissures between the lobes, and in the substance of this tissue the vessels are imbedded. This lobed condition of kidney is permanent in some animals, as, for instance, the otter and the seal tribes; it is also found in the bear, and still more remarkably in the cetaceans. In process of development, however, in the greater number of genera the lobes coalesce, and thus form a solid glandular organ, having a smooth, continuous surface, and presenting in the normal state no traces, or only very slight indications, of the original lobed condition. The kidney of the ox presents an appearance intermediate between the lobed condition, which is permanent in the animals before mentioned, and the solid form which is observed in the fully developed kidney of man, and most mamiferous genera. In this animal the medullary portion of the kidney has coalesced, while the cortical part is marked out by deep interlobar fissures. The coalescence of the lobes appears to have been arrested at a certain stage of its progress. We shall have again to refer to this original lobed condition of the human kidney.

The *medullary portion* is of a firmer texture and darker red colour than the cortical, and is disposed in the form of cones or pyramids (pyramids of Malpighi), the bases of which are directed towards the surface of the kidney, and are continuous with the cortical portion, while the apices, which are called *mamillary processes* or *papillæ*, are free, and directed towards the cavity of the pelvis. The number of these medullary cones has been variously stated by different anatomists; there are usually from twelve to fifteen in each kidney, but the number is not constant. Some of the cones are compound, being formed by the union of two, which have one common mamillary termination. The number of mamillary processes is, therefore, less by four or six than that of the medullary cones. The cut surface of each cone has a striated appearance, being composed of tubes which subdivide and radiate from the apex towards the base of each cone, where they merge into the cortical substance. The straight tubes in the medullary cones are commonly named the tubes of Bellini, that anatomist having been the first to demonstrate their tubular character; and they are continuous, as will presently be shown, with the convoluted tubes in the cortical substance. They are united by a firm net-work of fibrous tissue, in the substance of which there are some large veins, which take, for the most part, a straight course between the tubes. There are no Malpighian bodies in the medullary cones.

The *capsule* of the kidney is a firm, white, fibrous membrane, adherent by its external surface to the adipose tissue in which the kidney is imbedded, and connected on its inner side to the entire surface of the kidney. It sends numerous fibrous processes into the cortical substance, and small vessels pass from the kidney into the fibrous capsule. These connecting bands between the kidney and its capsule are easily torn when the capsule is stripped from the surface of the kidney. At the hilum of the kidney the capsule becomes continuous below with the ureter, and above with the fibrous layer of the pelvis; at the same point the bloodvessels receive an investment from this fibrous membrane, which is continued upwards with them until they finally break up into minute branches about the bases of the medullary cones.

Calyces, Infundibula and Pelvis.—The calyces are membranous or fibro-mucous cylinders, which receive in their upper extremities the apices of the mamillary processes. Where the membrane is reflected over the apices of the cones, it is perforated by the tubes of Bellini, from which a liquid may be seen to escape when pressure is applied to the cones. The calyces are less numerous than the mamillary processes; two or three mamillary processes being occasionally received into one calyx. The calyces unite into three small tubes, one corresponding with each extremity, and one with the central portion of the kidney; these, having somewhat of a funnel shape, are called *infundibula.* The infundibula soon unite to form the *pelvis* of the kidney, which is a membranous reservoir of a flattened oval figure, terminating below in the ureter. The pelvis and infundibula are usually surrounded by loose reticular and adipose tissue. The fibrous and mucous coats of the ureter are continuous with those of the pelvis, infundibula, and calyces.

Before we examine the minute structure of the kidney, it will be well to describe briefly the position of the bloodvessels about the medullary cones, so far as this can be ascertained by the unaided eye.

The renal artery, as it enters the hilum of the kidney, breaks up into four or five branches, and these again subdivide, a few of the branches passing behind the pelvis, while the greater number remain in front; they pass upwards between the calyces enclosed in folds of the fibrous membrane, and so they come in contact with the sides of the medullary cones. Each cone appears to be supplied by two arterial branches, which passing up, one on each side, form an anastomosing arch over the base of the cone. From this arterial arch branches proceed in all directions, the greater number passing into the cortical substance. The venous branches in this situation likewise form arches over the medullary cones, and have the same general arrangement as the arteries; they then unite into four or five trunks which are placed in front of the pelvis. There is no anastomosis between the arteries of neighbouring cones; each medullary cone, with its investing cortical substance, corresponds with one of the separate lobes of the embryo kidney; and although in the fully developed human kidney scarcely any trace of the original lobed division remains, yet the separation of the lobes, so far as their vessels are concerned, remains as distinct as in the permanently lobed kidney of the porpoise. When an injection is thrown into the vessels of one lobe, that lobe only is injected without the transfer of the injection through anastomosing vessels to neighbouring lobes. Obstruction of the artery which supplies one lobe will entirely prevent the injection of that lobe, while the surrounding parts are completely injected. It occasionally happens that during life the vessels supplying one or two lobes become obstructed, and, as a consequence, these lobes waste to an extreme degree, while the rest of the gland is perfectly nourished. Additional evidence of this complete vascular isolation of the lobes of the human kidney is afforded by certain other pathological conditions, to which reference will be made hereafter.

Minute Structure.—We have now, with the aid of the microscope, to examine in succession the following structures:—1st. The *fibro-cellular matrix.* 2ndly. The *tubes*, their course, division, and termination. 3rdly. The *Malpighian bodies*, and the *minute bloodvessels* with which they are closely connected. And 4thly. The *epithelium* in different parts of the surface over which the urine passes; commencing with that of the Malpighian bodies, and terminating with that of the pelvis and ureter.

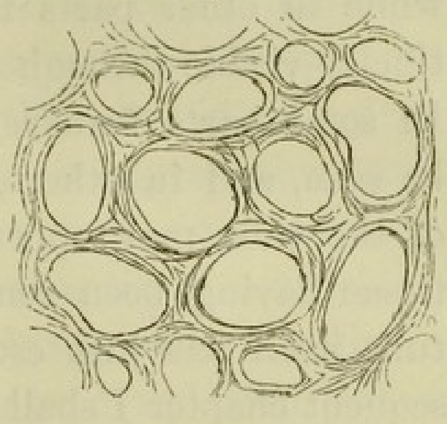
The *fibro-cellular matrix* of the kidney has been well and accurately described by Professor Goodsir.* It exists throughout every part of the renal structure, but its arrangement in the cortical substance differs from that in the medullary portion of the gland. It is best examined in a thin section of the cortical substance which has been macerated for a short time in water, so as to wash away the tubes and Malpighian bodies.

The smaller meshes are of nearly equal size, and are accurately filled by the tubes, each tube in its tortuous course passing through very many of the cells formed by this remarkable tissue. (Fig. 3.) The larger spaces are occupied by the Malpighian bodies. The meshes do not occupy any one plain or position rather than another; but in whatever direction the section

* *Monthly Journal of Medical Science,* May, 1842.

of the cortical substance is made, the same regular network presents itself. When the tubes are enclosed in the matrix, they often appear to be, as it were, mapped out into distinct circular or oval portions; an appearance which has, doubtless, confirmed some observers in the erroneous notion that the tubes terminate in blind extremities. This apparent

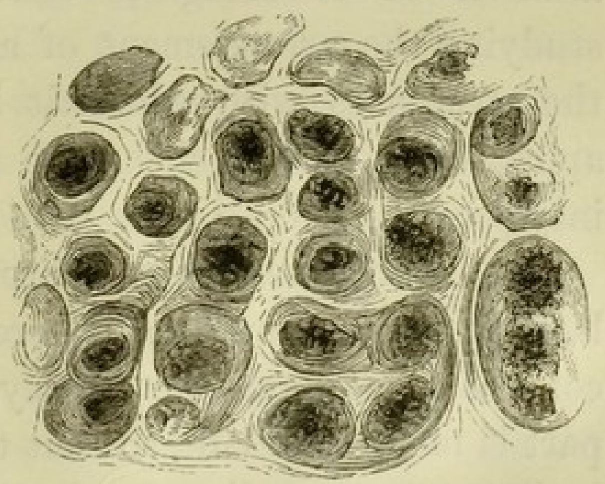
Fig. 3.



Fibrous matrix of the Kidney, showing the empty meshes after the removal of the tubes.

isolation of the different portions of what is, in reality, a continuous tube, is very much influenced by the condition of the tube itself. In the normal state, the colour of the tubes differs from that of the matrix, which, when free from blood, is commonly of a whitish colour, so that the tubes are visible through the substance of the matrix, and their continuity can be traced between the different meshes of the tissue. The same observation applies to the tubes when filled with blood. In some parts of such a specimen, por-

Fig. 4.



Sections of tubes filled with blood. The different portions are separated from each other by the fibrous tissues of the matrix, which contrasts by its light colour with the dark tubes enclosed within it.

tions of the tube may appear quite isolated, where they are partially concealed by the overlying matrix, while in other parts the tubes are more or less distinctly visible through the intervening fibrous tissue. In some parts transverse sections of the tubes may be seen, and in others, again, a considerable length of the tube may appear uncovered by matrix; this tissue having been removed by the knife, while the tube itself has just escaped the section. In a subsequent chapter I shall have to describe certain pathological changes, as a consequence of which the tubes lose their epithelial lining, and become more or less transparent; and in this condition, when they are packed in the meshes of the fibrous tissue, they have the appearance of separate globular or oval cells, and they have actually been described as such by able and experienced microscopical observers. (See fig. 14, chap. iv.) This question will be fully considered hereafter; the object of the present brief allusion to it being to show the importance of studying the arrangement of a tissue which gives to the structures with which it is connected peculiar appearances, and such as are very likely to be misinterpreted.

The arrangement of the fibrous tissue in the medullary cones is somewhat different from that in the cortical portion of the kidney. The tissue in this part is more abundant, so that the tubes are separated by it to a greater distance than in the cortical portion. The hardness and greater cohesion of the tissue of the medullary cones, as compared with that of the cortical portion, is chiefly due to the more abundant fibrous matrix in which the tubes of this part are packed. A transverse section of the cones shows the matrix in the form of circular meshes surrounding the tubes, as in the cortical portion; but in a longitudinal section, the meshes appear elongated, thus corresponding in form with the venous meshes which occupy the substance of the fibrous tissue, and which in this part of the kidney are elongated in the direction of the tubes. There being no Malpighian bodies in the medullary cones, the larger meshes of the matrix which contain these bodies are, of course, not present in this part of the kidney.

In order to understand the relation which the bloodvessels bear to the matrix, it is necessary to examine portions of a kidney which has been artificially injected, or one in which the vessels are filled with blood. It will then be seen that while the tubes accurately fill the meshes of the fibrous tissue, the capillary vessels, forming a plexus which surrounds the tubes, are contained in the substance of the same tissue. When the bloodvessels are empty, they cannot be distinguished from the fibrous tissue in which they are imbedded; it is only by the contrast of their colour, when filled with blood or with injection, that it can be ascertained that, in addition to the capillary vessels which surround the tubes, there is a connecting fibrous tissue, the office of which appears to be, to retain in position, and to support, the various complicated parts — tubes, Malpighian bodies, and bloodvessels—amongst which it is placed. In some parts of the matrix there may be seen elongated cells or nuclei, from which, apparently, the fibres are developed; they run parallel with the fibres, and often take a curved direction round the tubes which they enclose.

Tubuli uriniferi.—The tubuli uriniferi are so intimately connected with the Malpighian bodies, that it is not possible to give a complete description of one of these structures without frequent reference to the other. The general course and mode of division of the tubes, as well as their connexion with the Malpighian bodies, is best ascertained by the examination of specimens in which the tubes have been filled by injection; but our knowledge of the essential structure of the tubes, and particularly of their epithelial lining, would be very incomplete without a careful examination of uninjected specimens with a high magnifying power. The tubes may be more or less completely injected in two modes: 1st, by a liquid thrown into them from the pelvis of the kidney; and 2ndly, by the extravasation of materials forcibly injected into the bloodvessels of the Malpighian bodies. By the first mode the injected materials are made to enter the open mouth of the tubes, and to pass towards the other extremity, which, as will presently be shown, is closed; while by the second method the injection is admitted through the Malpighian vessels into the closed extremities of the tubes, whence it flows towards their open mouths, and so, in some instances, escapes into the pelvis of the kidney.

Tracing the tubes from the apex of a medullary cone, on the surface of which their open mouths may be seen, we find them taking a straight course through the pyramid, branching dichotomously, and diverging as they proceed. After reaching the base of the pyramid, their course through the cortical portion is very various; many tubes immediately take a very tortuous course, some of them bending down into the inter-pyramidal portions of the cortical substance; while other tubes pass on in sets and in straight lines towards the surface, the tubes on the sides of each bundle diverging successively, and taking a tortuous course through the cortical substance, so that only a few of the central tubes in each bundle retain their straight course quite up to the surface of the kidney; these finally turn backwards, making many convolutions in the cortical substance. After leaving the medullary cones, the branching of the tubes, except in very rare instances, appears to cease.

Some distinguished anatomists have maintained that the tubes, after dividing in the cortical substance, re-unite in a plexiform manner, and they have described this as their natural mode of termination. This opinion is in all probability founded on deceptive appearances, such as must have often presented themselves when the means of observation were less perfect than they now are. Others have maintained that the tubes terminate in free blind extremities unconnected with the Malpighian bodies; and they have based their opinion on the appearance of injected specimens, as well as on those of recent ones. With reference to this question Mr. Bowman* remarks, 'As the injection always stops short of the real extremities of the tubes, it must necessarily show apparent free extremities; and others may be produced by the section requisite for the examination of the part. As for the false appearances presented by recent specimens, they are obviously referable to the sudden bending down of a tube behind the part turned to the observer. In a mass composed of convolutions, many such would continually occur; and their real nature may be easily determined by the use of a high power and varying focus.' In addition to the sources of fallacy thus alluded to by Mr. Bowman, there is another, to which I have already referred,† when describing the fibrous matrix in which the tubes are packed. To an inexperienced observer, few appearances could be more deceptive than the apparently abrupt terminations of the tubes, as these are seen in the spaces formed by the surrounding tissue, here visible in the meshes of the network, and there suddenly concealed as they pass beneath the fibrous tissue.

The manner in which the tubes actually terminate is by becoming continuous with the Malpighian bodies. This fact, which can be demonstrated in many of the tubes, is a matter of fair inference and of moral certainty in all. The proofs of this fact, and the precise mode of continuity, we shall presently proceed to examine.

Structure of the Tubes.—The uriniferous tubes con-

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* *Phil. Trans.* 1842. † Ante, p. 18.

tain the two structures of which the mucous tissue is usually composed—viz., the *basement membrane* and the *epithelium*.*

The basement membrane is a thin, transparent, homogeneous lamina, simple and entire, without any aperture or appearance of structure. It forms the parenchymal wall of the uriniferous tubes; gives them their form, size, and stability; is in relation, on the one hand, with the vascular system of the organ and the fibrous matrix, and, on the other, with the epithelial lining of the tubes. The epithelium adheres to the inner surface of the membrane by organic union; it sometimes separates readily after maceration in water, and in one form of chronic disease of the kidney it frequently happens that the epithelial lining of many of the tubes is entirely removed, or only a few particles of epithelium remain scattered over the inner surface of the membrane. The basement membrane is united externally to the capillary venous plexus and the investing fibrous matrix; there is probably some organic connexion between these tissues, which permits the free transudation of materials from the blood-vessels through the basement membrane to the epithelial cells. When a tube deprived of its epithelium is detached from the surrounding tissues, the basement membrane is readily thrown into folds and wrinkles, and appears to possess a considerable amount of elasticity. The thickness of the membrane, according to Mr. Bowman, does not exceed $\frac{1}{20000}$th of an English

* *Cyclopædia of Anatomy*—Art. 'Mucous Membrane.'

inch. In certain diseased states its thickness is much increased, and simultaneously the cavity of the tube becomes dilated, so as greatly to exceed its normal diameter, thus constituting the serous cysts which are so frequently observed in the kidney. The basement membrane of the tubes is continuous, on the one hand, with the capsule of the Malpighian bodies, and, on the other, through the straight tubes of the medullary cones with the basement layer of the mucous membrane which lines the pelvis of the kidney.

The mean diameter of the tubes is about $\frac{1}{480}$ of an inch. The entire diameter of the convoluted tubes in the cortical portion somewhat exceeds that of the straight tubes in the medullary cones, although the cavity of the latter tubes is greater than that of the former; the larger canal of the straight tubes being a result of the difference in their epithelial lining. After the brief allusion just now made to the epithelium of the tube and its relation to the basement membrane, it will be convenient to postpone the particular consideration of this important structure until we have examined the Malpighian bodies.

Malpighian Bodies.—The Malpighian bodies have been objects of much interest since their discovery by the distinguished anatomist whose name they bear. Malpighi* ascertained that these bodies, which he calls internal glands, could be readily injected from the arteries to the branches of which they are appended. He further endeavoured to demonstrate the connexion

* *Exercitatio Anatom. de Renibus.*

which he believed to exist between these bodies and the urinary tubes. He did not succeed in his attempts to inject the tubes through the Malpighian bodies, and he confesses that his opinion as to the relation of these structures was derived rather from analogy than from anatomical demonstration; his idea being, that the urinary constituents were separated from the arteries of the Malpighian bodies, and that the tubes were the excretory ducts of these glands.

Ruysch* appears to have been the first to show that the urinary tubes may be injected through the arteries of the Malpighian bodies; and he supposed that the arteries become directly continuous with the tubes. Schumlansky,† while he confesses the great difficulty of arriving at an accurate knowledge of the structure of the Malpighian bodies and of their connexion with the tubes, appears to have had as definite an idea of these parts as it was possible to obtain with the imperfect means of observation at his command. He described the Malpighian bodies as consisting of a glomerulus of vessels, connected on the one side with the arteries, and on the other with the veins, and united by a cellular tissue in a manner which he did not very clearly explain. He believed that there is a close connexion between the Malpighian bodies and the tubes, as manifested by the fact that the tubes may be filled by a forcible injection of the Malpighian bodies through the arteries: further confirmation of this fact being afforded by the occasional passage of

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* *Thesaurus Anatom.* † *De Structurâ Renum. Argent.* 1788.

blood and other materials through the same channels, and the tubes being found filled with blood after death. With respect to the last observation, which he quotes from Bertin, he appeared to have some doubt, and suggested that the vessels containing the blood may have been bloodvessels and not uriniferous tubes.

Since the time of Schumlansky, whose work, here quoted, was published in the year 1788, scarcely any addition was made to our knowledge of the structure of the Malpighian bodies until Mr. Bowman's paper appeared in the *Philosophical Transactions*.*

Mr. Bowman has so clearly and so accurately demonstrated the structure of these bodies, that he has left little work for any subsequent observers. And although some parts of his description have been questioned, I believe that it is correct in every minute particular.

The Malpighian bodies consist of a rounded mass of minute bloodvessels, invested by a cyst or capsule. The capsule was first particularly described by Müller, who believed it to be closed on all sides except at one point, where it is perforated by the bloodvessels. Mr. Bowman, observing that the capsule of the Malpighian bodies had an appearance precisely similar to that of the basement membrane of the tubes, and seeing these similar tissues in such close proximity, was led to suspect that the capsule was, in fact, the basement membrane of the tubes expanded over the vessels, and after some time he succeeded in obtaining an unequivocal

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* On the Structure and Use of the Malpighian Bodies of the Kidney. *Phil. Trans.* 1842.

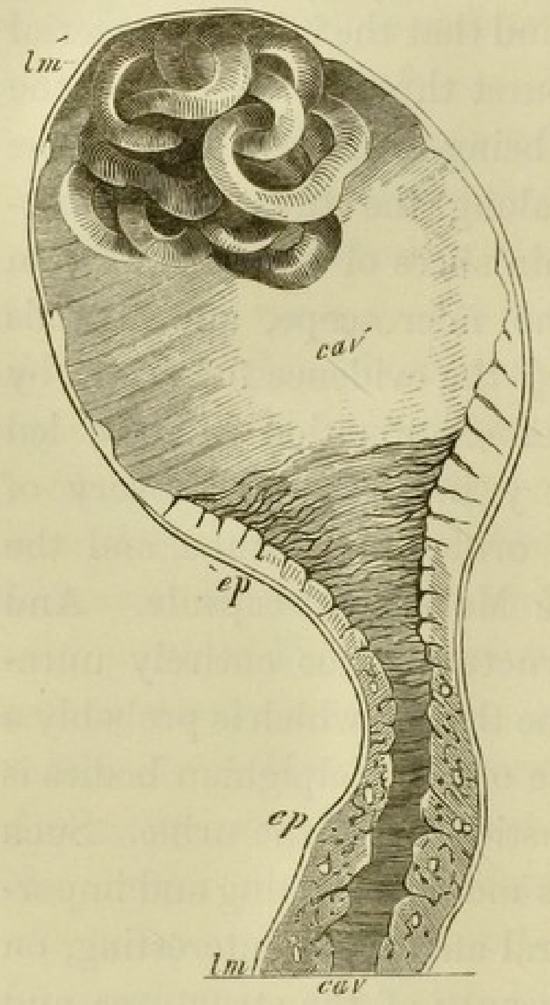
view of their continuity. This important result was first arrived at after the use of the *double injection.* After the injection of some kidneys through the artery by this method, it was found that the injected material had, in many instances, burst through the tuft of the Malpighian vessels, and being extravasated into the capsule, had passed off along the tube. He subsequently also examined thin slices of the recent organ with high powers of the microscope, and in this manner fully corroborated the evidence furnished by injections. This mode of examination likewise led Mr. Bowman to the very interesting discovery of ciliary motion within the orifice of the tube, and the contiguous portion of the Malpighian capsule. And a consideration of the structures thus entirely unravelled, suggested to him the theory, which is probably a correct one, that the office of the Malpighian bodies is to separate the watery constituents of the urine. Such is the brief history of this most interesting and important discovery in structural anatomy—interesting, on account of the extreme beauty of the structures and their wonderful adaptation to the office assigned them; and important, on account of the aid thereby afforded in the investigation of the pathology of the kidney.*

The Malpighian capsule has a globular or oval form, and is composed of a simple, homogeneous basement

* The structure of the Malpighian bodies may be most satisfactorily examined in some of the lower animals, and probably in none more so than in the common newt, from which fig. 5 is taken. The kidneys of these animals are of a pyramidal form, and at the apex of the pyramid the tissue is very thin and transparent, so that

membrane, in which no structure can be discovered. It is a continuation of the basement membrane of the tube, into which it may be seen to pass off as the body of a Florence flask into its neck. The cavity of the capsule is also continuous with that of the tube. At a point directly opposite to the tube the capsule is perforated by two vessels, the one passing in to give off the Malpighian tuft of capillaries, the other passing out to convey the blood from these capillaries into vessels which lie on the outer surface of the tubes. The capsule is united to the perforating vessels at their point of transit, but in what precise manner it is difficult to determine.

Fig. 5.



Malpighian body and portion of tube from the Kidney of a Newt.

cav. Cavity of tube.
cav′. Cavity of capsule.
lm. Basement membrane of tube.
lm′. Basement membrane of capsule.
ep. Epithelium of tube.
èp. Epithelium of capsule, transparent and ciliated. The empty capillaries occupy the part of the capsule opposite to the tube.

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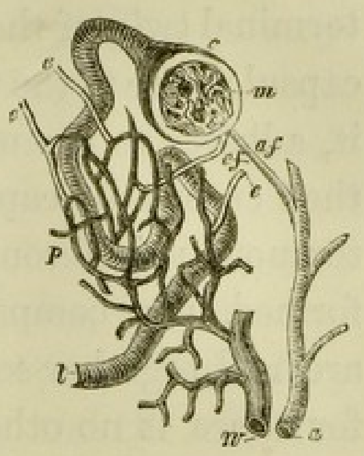
a small portion, removed with sharp scissors, may be at once submitted to examination without further tearing or injury. The tissues are loosely packed, the Malpighian bodies very large, and the structure and relations of parts may be seen with great clearness.

In order to give a distinct idea of the Malpighian capillaries, it will be necessary to describe the circulation through the kidney.

According to the observations of Mr. Bowman, ' All the blood of the renal artery (with the exception of a small quantity distributed to the capsule, surrounding fat, and the coats of the larger vessels) enters the capillary tufts of the Malpighian bodies; thence it passes into the capillary plexus surrounding the uriniferous tubes, and it finally leaves the organ through the branches of the renal vein.'—(Fig. 6.)

Fig. 6.



Plan of the renal circulation, after BOWMAN.

The artery, *a*, is seen giving a terminal twig, *a f*, to a Malpighian tuft, *m*, from which emerges the efferent vessels, *e f*. Other efferent vessels, *e e e*, are seen. All these enter the plexus of capillaries, *p*, surrounding the uriniferous tube, *t*. From this plexus the emulgent vein, *w*, springs. Magnified about forty diameters.—BOWMAN.

Following it in this course, I shall give Mr. Bowman's description of the vascular apparatus, and the nature of its connexion with the tubes.

With the inconsiderable exceptions above mentioned, the terminal twigs of the artery correspond in number with the Malpighian bodies. Arrived here, the afferent vessel perforates the capsule and suddenly breaks up into two, three, four, or even eight branches, which diverge in all directions like petals from the stalk of a flower, and usually run in a more or less tortuous manner, subdividing again once or twice as they advance over the surface of the ball they are about to form. The vessels resulting from these subdivisions are capillary in size, and consist of a simple homogeneous, transparent membrane. They reunite into a single small vessel, which varies in size, being generally smaller, but in some situations larger, than the terminal twig of the artery. This vessel perforates the capsule close to the terminal twig of the artery, and, like it, adheres to the membrane as it passes through. It then enters the capillary plexus which surrounds the tortuous uriniferous tubes. The tuft of vessels, thus formed, is a compact ball, the several parts of which are held together solely by their mutual interlacement, for there is no other tissue admitted into the capsule besides the bloodvessels. It is subdivided into as many lobes as there are primary branches of the terminal twig or afferent vessel, and these lobes do not communicate, except at the root of the tuft. The surface of the tuft is everywhere unattached and free. The whole circumference of every vessel composing the tuft is also free, and lies loose in the cavity of the capsule. *The vessels are so perfectly bare, that in no other situation in the body do they admit of being so satisfactorily studied.** The blood, leaving the Malpighian tufts, is conveyed by their efferent vessels, which are always

* The statement contained in italics has been questioned by some observers; and in the article *Ren*, I introduced an illustration (No. 160) of a 'Malpighian tuft of capillaries covered with transparent nucleated cells (after Gerlach).' I have since ascertained that the appearance of cells on the surface of the capillaries is delusive, and that Mr. Bowman's original statement as to the vessels being quite naked is strictly correct. I have now introduced an illustration, similar to the one above mentioned, into the pathological part of this treatise (fig. 10, chap. iii.), and I have there given what I believe to be the correct interpretation of the appearance.

single and never inosculate with one another, to the capillary plexus surrounding the uriniferous tubes. The vessels of this *inter-tubular plexus* lie on the outside of the tubes, in the substance of the matrix, and in contact with the basement membrane. They everywhere anastomose freely, so that throughout the whole organ they form one continuous network. The vessels of the inter-tubular plexus having conveyed the blood to the outer surface of the convoluted tubes, then unite to form the small venous radicles, the arrangement of which on the cortical surface of the kidney has been already described (p. 9), and the union of which constitutes the renal or emulgent vein. The efferent vessels from the larger Malpighian bodies near the bases of the medullary cones take a course towards the pelvis of the kidney between the straight tubes. They branch again and again in the manner of arteries, and form the plexus with long meshes (see p. 19), which invests this part of the tubes. Some of the veins springing from this plexus form a network on the nipple-shaped extremities of the cones, around the orifices; and thence take with the remainder a backward course, likewise parallel to the tubes, to empty themselves into the venous branches that lie about the bases of the cones. The veins from the capsule and surrounding fat join the renal vein in some part of its course. It is probable that the capillaries of the vasa vasorum, within the substance of the organ, pour their blood into the capillary plexus surroundiug the tubes, as those of the hepatic artery do into the portal hepatic plexus of the lobules of the liver.

Thus there are in the kidney two perfectly distinct systems of capillary vessels, through both of which the blood passes in its course from the arteries into the veins: the first, that inserted into the dilated extremities of the uriniferous tubes, and in immediate connexion with the arteries; the second, that enveloping the convolutions of the tubes, and communicating directly with the veins. Mr. Bowman has applied the term '*portal system of the kidney*,' to the series of efferent vessels connecting these two sets of capillaries, on account of the close analogy it seems to bear to the vena porta, intervening, like it, between two capillary networks. The capillary plexus surrounding the tubes differs, therefore, from that of other glands, and agrees with that of the liver, in its receiving blood that has previously traversed another system of capillary vessels. Having thus described the two capillary systems of the kidney, and having traced the circulation from the arteries through the two sets of capillaries into the renal vein, we must return to the Malpighian bodies, for the purpose of noting one or two particulars which have not been mentioned.

In all the vertebrate classes of animals the Malpighian bodies have essentially the same structure; the capsule being formed by the dilated extremity of a uriniferous tube, into which a single mass of blood-vessels is inserted. In some orders of animals there are modifications which are not without physiological interest. Some of them are described in the article Ren, in the *Cyclopædia of Anatomy*.

The diameter of the Malpighian bodies varies considerably in different animals. In the human subject the mean diameter is $\frac{1}{104}$ of an inch, the range being from $\frac{1}{80}$ to $\frac{1}{144}$ of an inch.

Epithelium.—In describing the epithelium of the kidney it will be convenient to begin with that of the Malpighian capsules, and so to continue and complete the description of these bodies.

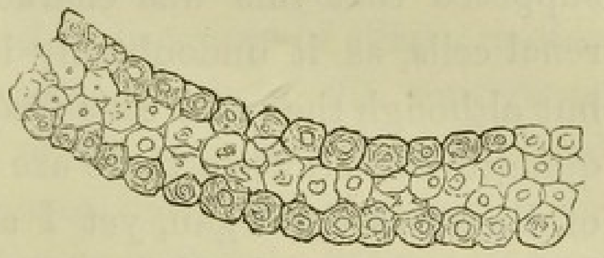
While speaking of the Malpighian capillaries it has already been stated that they lie entirely uncovered within the capsule, having no cells of any kind upon their surface. The only epithelium belonging to the Malpighian bodies is that which lines the capsule. The epithelium covering that part of the capsule which is contiguous to the orifice of the tube is delicate and transparent, and without distinct nuclei; thus contrasting remarkably with that in the tube itself, which we shall find to be opaque, granular, and nucleated; the structural difference being associated with a diversity of function of great interest and importance. (Fig. 5, p. 28.) Mr. Bowman first observed that the epithelium within the Malpighian capsule of the frog is covered with vibratile cilia. This ciliated epithelium covers about one-third of the inner surface of the capsule—that nearest the orifice of the tube; beyond this point the cilia cease, and the epithelium is of excessive delicacy and translucence, while in many instances it is impossible to detect the slightest appearance of epithelium beyond the line where the cilia cease. (Fig. 5, p. 28.) Since the publication of Mr. Bowman's paper, ciliated epithelium has been observed in the Malpighian bodies of various other reptiles and in fishes; but hitherto, I am not aware that it has been seen in the class of mammalia or in birds. I shall presently (p. 40) suggest some considerations which render it probable that cilia do actually exist in the Malpighian bodies of these animals, although it is very difficult, if not impossible, to observe them. With the exception of the cilia, which have not yet been observed in the kidneys of man, the preceding description is strictly applicable to the Malpighian bodies of the human kidney.

Epithelium of the uriniferous tubes.—The epithelium of the uriniferous tubes presents itself in two distinct forms, the one kind existing in the convoluted tubes of the cortex, and the other in the straight tubes of the medullary cones.

In that constricted part of the tubes which forms, as it were, the neck of the Malpighian capsule, the epithelium has the same characters as that which covers the contiguous portion of the capsule, consisting of delicate transparent particles, which in fishes and reptiles, are covered with vibratile cilia. The strict physiological line of demarcation between the Malpighian body and the tube is that where the transparent epithelium is replaced by that which we have next to describe; so that it is better to call the constricted portion of tube which contains this transparent epithelium, *the neck of the Malpighian capsule.*

In the convoluted tubes which intervene between the neck of the Malpighian capsule and the base of the medullary cones, the epithelium has the form to which the term spheroidal or glandular is commonly applied.* The cells have a more or less rounded form, and are thus distinguished from the flattened particles of the lamelliform, or scaly variety of epithelium. (Fig. 7, see also fig. 5, p. 28.) They usually form a single layer, covering the surface of the basement membrane, and they occupy about one half the diameter of the tube, leaving a canal in the centre, the diameter of which is rather less than the combined thickness of its epithelial walls; so that in a tube with an entire diameter of $\frac{1}{450}$ of an inch, there would be a free canal having a diameter of from $\frac{1}{900}$ to $\frac{1}{1000}$ of an inch.† The cells are granular and opaque, and appear to contain a considerable quantity of solid matter; their walls are very delicate, and when water is added to the specimen, the cells frequently fall in pieces very rapidly. In this respect the cells of the kidney differ remarkably from those of the liver; the latter having much thicker and firmer walls, which offer a greater resistance to the action of water. The cells have one distinct nucleus, sometimes two, and in the centre of

Fig. 7.



Portion of a convoluted tube, with its lining of glandular epithelium.

* *Vide* Mr. Bowman's article, 'Mucous Membrane,' in the *Cyclop. of Anat. and Phys.*

† It will be seen hereafter that the knowledge of these relative measurements has a practical value, and sometimes forms an important element in diagnosis and prognosis.

the nucleus a nucleolus is often visible. Another interesting feature in these cells consists in their sometimes containing minute oil globules. I formerly supposed that this was characteristic of the healthy renal cells, as it undoubtedly is of the hepatic cell; but although the renal cells frequently contain minute quantities of oil when there are no very decided marks of disease in the organ, yet I am now convinced that it is rare to find oil in the cells unassociated with some other appearances of a deviation from the strictly normal condition of the epithelium.

The epithelium lining the straight tubes of the medullary cones differs essentially from that of the convoluted tubes; the latter, as already described, is the true spheroidal or secreting epithelium, while the former resembles the lamelliform or pavement variety. Its particles are here smaller and more flattened than in the convoluted tubes, so that the epithelium is thinner in proportion to the diameter of the tube, while the canal is larger than in the convoluted tubes. The cells in the straight tubes have smooth and transparent walls, their contents have not the opaque and granular appearance which is characteristic of the epithelium before described, and they rarely, if ever, contain oil, even when the epithelium of the convoluted tubes is distended by a morbid accumulation of oil. The epithelium here, too, appears to adhere much more closely to the basement membrane, and to be less easily detached from it than is the case with the epithelium in the convoluted tubes. It will presently be shown that these structural differences in the epithelium of the straight and the convoluted tubes indicate an essential diversity of function.

Allusion has already been made (p. 27) to Mr. Bowman's very interesting discovery of ciliary motion in the Malpighian capsules, and in the contiguous portions of the tubes of the frog, and it was stated that a similar phenomenon had been observed in the kidney of other reptiles, as well as in fishes. It now remains to be mentioned that this wonderful phenomenon of ciliary motion has been found to extend in the same classes of animals throughout nearly the whole length of the uriniferous tubes.

In 1845, A. Kölliker published a short paper,* in which he states that in the kidney of the embryo lizard the uriniferous tubes are lined by epithelium remarkable for distinctly developed ciliary processes, which may be seen in vigorous action for some time after the death of the animal. The ciliated epithelium exists throughout the whole length of the tubes, except near the common excretory duct. He also observed the cilia at the entrance of the Malpighian capsule. In a note appended to Kölliker's paper, the editor (J. Müller) states that he has observed the same phenomenon in the uriniferous tubes of a fish, (*Raia Clavata.*) The cilia are very large and long; they are directed along the axis of the tube, and have a wavy motion like that of a whip-lash.

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* Ueber Flimmerbewegungen in den Primordialnieren.—Müller's *Archiv.* 1845, and *Edinburgh Med. and Surg. Journal*, vol. 68.

Before I was aware of the observations just now referred to, while examining the kidney of the newt, (Triton and Lisso-triton,) I was surprised to find vibratile cilia in active motion, apparently extending throughout the whole length of the uriniferous tubes.* In a carefully prepared specimen I have sometimes seen the cilia in rapid action throughout the whole length of nearly every tube in the field of the microscope; and, certainly, few microscopic objects can be more interesting or wonderful. The motion commences within the Malpighian capsule; any little particles floating in the liquid of the capsule are darted into the orifice of the tube with marvellous precision, and thence they are directed onwards through the windings of the tube in a current of liquid, which is propelled by the continual rapid lashing of the cilia with great regularity and speed. Much violence in tearing up the specimen for examination arrests the motion; and when water is added to the preparation, the epithelial particles, imbibing the liquid, swell and gradually fill up the cavity of the tube, so as at once to retard, and quickly to arrest the motion of the cilia. When the cilia are very active, they present an appearance of a rapid flickering movement, without any distinction of separate cilia; when they are in slow motion, their form and the direction of their movement may readily be observed; *but when their motion has entirely ceased*, *I*

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* In a note at page 27, I have described the mode of preparing the kidney of this animal for microscopical examination.

have never been able to see them distinctly even with the best object-glasses, and when their previously active motion has indicated their exact position. The motionless cilia appear to collapse upon the surface of the epithelium, and so become invisible.

I have observed cilia throughout the tubes in the frog and in the snake; but in these animals it is much more difficult to obtain specimens of the cilia in action, for the reason that the kidneys being of comparatively large size it is necessary to make thin sections for examination, and the violence thus done to the tissues arrests the motion of the cilia, and so renders them invisible. For the same reason it is difficult to see them in any part of the newt's kidney, except in the thin and transparent anterior extremity. (See note, p. 27.) When specimens are obtained from the thicker parts of the kidney, near the base; although here and there a tube appears with the cilia in full action, yet the greater number of tubes present no appearance of cilia. But to the thicker parts of the newt's kidney, as well as to the entire kidneys of larger animals, we may reasonably apply the rule *ex uno disce omnes*—if the cilia can be detected in one or in a few tubes, it may safely be inferred that they exist in all.

I have not as yet succeeded in finding cilia in the kidneys of birds or mammalia, and I am not aware that any other observer has been more successful in the search than myself. Assuming that they exist in these animals, which appears in the highest degree probable, it must be very difficult, if not impossible, to detect them, since, besides the difficulty arising from the large size of the kidneys, and the consequent necessity of doing violence to the tissues in preparing them for examination, there is an additional obstacle in the well-known fact that ciliary motion, and all other vital phenomena in the higher animals, continue for a much shorter period after death, and are suspended by a much less degree of violence than is the case in the cold-blooded animals. It has already been stated, that in the reptile's kidney the cilia become invisible after their motion has ceased; this is probably the case in the human kidney, where there certainly appears an urgent necessity for this motor force; for it is difficult to conceive the possibility of the urine passing continuously through the long and tortuous tubes without the assistance of ciliary motion. In a subsequent part of this treatise (chap. iv.) will be found a suggestion that the dilatation of the tubes into cysts by an accumulation of liquid within them, may be, in part, explained by the destruction of the cilia, together with the epithelial lining of the tubes.

The epithelium of the pelvis and ureter requires only a brief mention: it belongs to the lamelliform or scaly variety, and consists of flattened, delicate, transparent scales, having an angular outline caused by their lateral apposition, and a nucleus which is generally eccentric.

FUNCTION OF THE KIDNEYS.

Before giving an account of the physiology of the kidneys, it will be well to advert to the sources of the urine, and to describe the physical and chemical characters of the secretion.

SOURCES OF THE URINE.

The urine may be said, physiologically, to have two sources, the one consisting of the liquids and solids which are introduced into the stomach as food, and the other of materials derived from the disorganization of the tissues, which, having served their purpose in the economy, are subsequently eliminated by the kidneys.

The introduction of water into the blood, either through the stomach or the skin,—as, for instance, after a cold bath,—is quickly followed by a copious secretion of pale urine; and this indicates one source of the liquid portion of the urinary secretion. And that a portion of the solid constituents of the urine is derived from the food is shown by the fact that the products of an imperfectly digested meal may frequently be detected in the renal secretion. It frequently happens that the urine of dyspeptic patients has its density much increased after the period of digestion is over, in consequence of the large amount of unassimilated food which, in the form of lithate of ammonia, or in other states of chemical combination, is eliminated by the kidneys. One of the duties of the kidneys, therefore, is to remove from the system those elements of the food which, after being introduced into the blood, are either superfluous or unfit for the nourishment of the tissues. A third office of the kidneys is, as before suggested, the excretion of those products of the disorganization of the tissues which are of no further use within the system, and the retention of which in the blood would be attended with injurious and even fatal consequences. This disorganizing process is in constant operation. Every movement of the body, every act of respiration or secretion, is either a cause, or a consequence, or an evidence, of chemical change in the various tissues.

It is of practical importance to distinguish three varieties of urine. First, that passed after drinking freely of watery liquids, *urina potûs;* this is usually pale, and of comparatively low specific gravity. Second, that secreted after the digestion of a meal, *urina cibi;* this varies much in its physical characters, its density being usually high. Third, that secreted on first rising in the morning, and which is derived from the blood, uninfluenced by food or drink, *urina sanguinis.* The physical characters and the density of this urine of the blood are, in general, more uniform than those of the other varieties, and any remarkable deviation from the standard of health is usually an indication of serious disease.

PHYSICAL CHARACTERS OF THE URINE.

For the purposes of diagnosis it is important to observe the physical characters of the urine, noting especially its colour and its density.

Healthy human urine, when recently voided, is a clear, limpid liquid, of a light amber or sherry colour. At this time it reddens litmus paper, and its odour is slightly aromatic. As it cools, the aromatic odour is replaced by another, which is peculiar and *urinous.*

At length the urine undergoes decomposition, becoming alkaline, and having an ammoniacal, fœtid smell.

The mode of finding the specific gravity of the urine by means of the urinometer is so familiarly known as to need no description. In all cases where accuracy is required, an average sample of the urine passed in twenty-four hours should be obtained; but when this is not practicable, the patient should be requested to furnish specimens of the urine passed immediately before going to bed, and of that voided on rising in the morning. The average density of these two specimens will give a near approach to the truth.

The *specific gravity* of the urine has been variously estimated by different observers. After long and careful attention to the subject, Dr. Prout arrived at the conclusion that the standard specific gravity of the urine of a healthy person, during the whole year, in this country, scarcely reaches 1020. And he considers that we shall be near the truth if we estimate the specific gravity to range from 1015 in the winter, to 1025 in the summer. This conclusion agrees with the observations of Dr. Golding Bird,* and differs little from the results of some careful researches by Dr. Routh,† who has shown, from an average of eighteen cases, that 1021 very nearly represents the specific gravity of the urine secreted in twenty-four hours.

The *quantity* of urine secreted in twenty-four hours is usually greater in winter and in cold climates than in summer and in warm climates. This difference of

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* *Urinary Deposits*, p. 46. † *Med. Gazette*, Sept. 1850.

quantity depends on the vicarious action of the skin and kidneys, the former carrying off more water in warm weather, and the latter under the influence of cold. Dr. Prout estimates the normal quantity in this country to be from thirty ounces in the summer to forty ounces in the winter. It is obvious that, *cæteris paribus*, the quantity and the specific gravity will vary inversely.

For the practical purposes of diagnosis and prognosis it is often important to ascertain the amount of the solids or 'real urine' discharged in twenty-four hours. The first step in an inquiry of this kind is to obtain an accurate measure of the quantity of urine secreted. The patient should be directed to pass water at a certain hour, and, rejecting what is then voided, to keep all that he passes up to the same hour on the following day, when he is to empty his bladder completely. The amount of liquid urine secreted is no index of the manner in which the kidneys are discharging their functions, for a certain measure of urine having a specific gravity 1015, will contain only about as much solid matter as half the quantity of urine of the density 1030.

The proportion of solids in the urine can be accurately determined only by the evaporation of a given quantity, and weighing the dry residue. *An approximation to the truth*, however, can be gained by a calculation based upon the specific gravity of the urine. For this purpose different formula have been proposed. One suggested by Dr. Christison has been adopted by

Dr. Golding Bird; it having been shown by Dr. Day* to be the most exact. According to Dr. Christison, if D = the density or specific gravity of the urine, and $\triangle$ = the difference between 1000 and its density, the quantity of solids in 1000 grains = $\triangle \times 2{\cdot}33$. Suppose, for example, that the specific gravity of the urine is 1020, then $20 \times 2{\cdot}33 = 46{\cdot}60$, which is the amount of solids in 1000 grains of the urine. From Dr. Christison's formula Dr. Golding Bird has calculated a table, which shows, at a glance, the quantity of solids and liquid in 1000 grains of urine of different densities, from 1001 to 1040. Another still more convenient table, which Dr. G. Bird has calculated from Dr. Christison's formula, shows the number of grains of solids in, and the weight of, a fluid ounce of urine of every density, from 1010 to 1040. This table I have extracted, for the use of my readers.

Specific gravity.	Weight of one fluid ounce.	Solids in one ounce.	Specific gravity.	Weight of one fluid oz.	Solids in one ounce.
		Grs.			Grs.
1010	441·8	10·283	1025	448·4	26·119
1011	442·3	11·336	1026	448·8	27·188
1012	442·7	12·377	1027	449·3	28·265
1013	443·1	13·421	1028	449·7	29·338
1014	443·6	14·470	1029	450·1	30·413
1015	444·	15·517	1030	450·6	31·496
1016	444·5	16·570	1031	451·0	32·575
1017	444·9	17·622	1032	451·5	33·663
1018	445·3	18·671	1033	451·9	35·746
1019	445·8	19·735	1034	452·3	36·831
1020	446·2	20·792	1035	452·8	37·925
1021	446·6	21·852	1036	453·2	38·014
1022	447·1	22·918	1037	453·6	39·104
1023	447·5	23·981	1038	454·1	40·206
1024	448·0	25·051	1039	454·5	41·300

* *Lancet,* 1844, p. 370.

An inspection of the table shows a curious coincidence between the figures expressing the densities and the weight of the solids in a fluid ounce of the urine. Thus the specific gravity of the urine being expressed by four figures, the two last will indicate the quantity of solids in a fluid ounce, within an error of little more than a grain, when the density does not exceed 1030; above that number, the error is a little greater. The recollection of this fact will enable us, as suggested by Dr. G. Bird, to form a tolerably correct estimate of the daily discharge of solids, even at the patient's bed-side, when the table may not be at hand to refer to. The mode of using the table is to ascertain the specific gravity of the urine, and to multiply the number which represents the amount of solids contained in urine of that density by the number of fluid ounces passed in twenty-four hours. Suppose, for instance, that the specific gravity is 1020, and the quantity passed 30 ounces, then $20{\cdot}792 \times 30 = 623{\cdot}760$ grains of solids. According to Dr. Golding Bird, 'it appears from a large number of observations, that the average amount of work performed by the kidneys in the adult may be regarded as effecting the secretion of from 600 to 700 grains of solids in twenty-four hours. Although certain peculiarities connected with muscular exercise, regimen, and diet, as well as certain idiosyncrasies of the patient, may influence this, yet, if we regard 650 as the average expression of the number of grains of effete matter excreted in twenty-four hours by the kidneys, we shall not commit any serious error. In calculations of this kind, much latitude must be allowed; and it ought at least to be granted, that the kidneys may excrete fifty grains more or less than the assumed average, without exceeding or falling short of their proper duty.'

CHEMICAL CHARACTERS AND COMPOSITION OF THE URINE.

The urine, as before stated, has normally an acid reaction, but the degree of acidity is very variable. This subject has been carefully investigated by Dr. Bence Jones,* who has discovered that the secretions of the stomach and of the kidneys are opposite as regards their acidity, the gastric fluids being most acid when the urine is least so, and *vica versâ*. The urine is most acid immediately before meals, and its acidity decreases during digestion, the decrease being greatest about three hours after breakfast, and five or six hours after dinner. The digestion of animal food diminishes the acidity more than that of vegetable food; and under the influence of a vegetable diet, the increase of acidity before meals is more decided.

With reference to these interesting observations of Dr. Bence Jones, it is obvious that the question of the urine being abnormally acid or alkaline, can be determined only by the examination of all the urine passed during the day; and that to prescribe either acid or alkaline medicines, after the examination of

* *Animal Chemistry.* London, 1850.

only a single specimen of urine, and without regard to the time of the last meal, is an injurious practice. According to Liebig, the acidity of the urine is due to the presence of the acid phosphate of soda.

The analysis of the urine by M. Becquerel was adopted by Dr. Prout as being the most accurate. Dr. Prout took as a standard, 35 ounces of sp. gr. 1020, and employing M. Becquerel's data as the basis of his calculation, he obtained the results which are shown in the following table; the proportion of solids and liquids being 33 of the former to 967 of the latter.

COMPOSITION OF 1000 PARTS OF URINE.

Water			967·
Urea			14·230
Uric acid			·468
Organic matters inseparable from each other	Lactic acid (?) Colouring matters Extractive matters		10·167
Salts	Chlorides Phosphates Sulphates	Ammonia Lime Soda Potash Magnesia	8·135
			1000·000

Urea was first analyzed by Dr. Prout. Its chemical composition is, $C_2\ N_2\ H_4\ O_2 = 60$. It forms nearly one-half of the solid constituents of the urine, and is the chief agent by which the nitrogen of the decomposed tissues and superfluous food is excreted from the body; 270 grains of urea, or more than half an ounce, being on an average excreted by a healthy man in twenty-four hours. When solid, it assumes the form of a four-sided prism. Its crystals are colourless; they have a faint, peculiar smell, and a saline taste. Urea is neither acid nor alkaline, but it combines with acids like a feeble base. It is very soluble in hot and cold water, and in alcohol. It exists ready-formed in the blood, and accumulates after extirpation of the kidneys in animals, or when, in the human subject, the excretory power of the kidneys is impaired by disease. It appears to be derived from two different sources. That it is in part derived from the unassimilated elements of nitrogenous food is shown by the immediate increase in the quantity of urea occasioned by substituting an animal or highly nitrogenous for a vegetable diet; and that it is partly derived from the disorganization of the tissues, is proved by its being continually excreted, though in smaller quantities, when all nitrogenous articles are excluded from the food, and even after long fasting. The excretion of urea is increased by exercise; the quantity excreted by men in the prime of life is usually greater than by women of the same age; and in both sexes the quantity voided in the middle period of life is greater than in old persons, or in infants.

In composition it is identical with hydrated cyanate of ammonia $C_2\ N_2\ H_4\ O_2 = C_2\ NO,\ NH_3\ HO$. It is readily decomposed into carbonate of ammonia, one atom of urea, with two atoms of water, being equal to two atoms of carbonate of ammonia—$C_2\ N_2\ H_4\ O_2 + 2\ HO = 2\ CO_2\ NH_3$. This decomposition occurs not only when the urine is kept for some days after being voided, but it frequently happens during life in the bladder, especially when the mucous membrane of that organ is diseased, and it may even occur in the blood. Bernard and Barreswil* discovered that after extirpation of the kidneys in dogs, carbonate of ammonia, the product of decomposed urea, is eliminated by the gastro-intestinal mucous membrane. And Frerichs† states, that always in the human subject, where symptoms of poisoning by retained urinary excrement have existed during life, carbonate of ammonia, as well as undecomposed urea, may be detected in the blood.

Uric Acid. — Chem. comp., $C_{10}\ N_4\ H_4\ O = 168$. Like urea, it exists ready formed in the blood, a discovery for which we are indebted to Dr. Garrod.‡ On an average 8·1 grains of this substance is excreted in twenty-four hours. It forms less than $\frac{1}{2000}$ part of the urine in man; but its proportion varies much in different animals. According to Dr. Prout, it requires 10,000 parts of water for its solution, and it is supposed to be combined in the urine with ammonia; the lithate of ammonia being a much more soluble compound. From this combination it is readily separated by the addition of an acid to the urine, the lithic acid then falls in the form of rhombic crystals, which have usually a brownish-yellow colour. Dr. Prout supposed that while urea was a product of the decom-

* *Archives Générales de Médicine.* 1847.
† *Die Bright'sche Nierenkrankheit.* 1851. P. 104.
‡ *Med.-Chir. Trans.*, vol. xxxi.

position of the gelatinous tissues, uric acid resulted from a like disintegration of the albuminous tissues. The notion that uric acid results from the metamorphosis of one set of tissues, and urea from another, is rendered improbable, as suggested by Dr. G. Bird, by the fact, that some animals excrete no urea, although structures physiologically identical with those of man must undergo decomposition. Liebig, on the other hand, maintains that uric acid is the immediate product of the decomposition of all the nitrogenous tissues, and that if a due supply of oxygen is afforded, the uric acid is converted into urea and carbonic acid. This view is opposed by the fact that in birds, whose perfect respiration ensures a large supply of oxygen, uric acid is abundantly excreted in the form of uratè of ammonia, while very little urea is eliminated. The relations between urea and uric acid therefore remain, at present, undetermined. That uric acid is, in part, derived from the unassimilated elements of nitrogenous food, is proved by the immediate influence of animal diet in increasing the excretion of uric acid like that of urea. Dr. Bence Jones found that the quantity of uric acid

	Sp. Gr.		Grs.
After animal food, in 1000 gr. of urine,	1·027	was	1·022
Before	1·024	„	0·049
After vegetable food	1·025	„	1·010
Before	1·024	„	0·049

Lactic Acid.—Although lactic acid exists in the juices of the human body, and in the perspired fluid, it appears doubtful whether it is normally present in human urine; that which was mistaken for lactic acid being, as it appears, a mixture of creatine and creatinine.

Creatine and Creatinine are two nitrogenous substances which were first discovered in the urine by Dr. Pettenkofer; and Liebig has proved their identity with a crystallized body which had long before been described by Chevreul in the juices of flesh. Creatine has the following composition:—$C_8\ H_{11}\ N_3\ O_6$. It occurs in colourless, transparent, rhombic crystals, and is perfectly neutral.

Creatinine has a similar composition, but with less water:—$C_8\ H_7\ N_3\ O_2$. It crystallizes in small prisms, and has a strongly alkaline re-action. Creatine is readily converted into creatinine by digestion in mineral acids, and the same change probably occurs during putrefaction.

These substances have hitherto been found in no other tissues than the muscular. It is probable that they are the immediate result of the metamorphosis of muscular tissues, and that, subsequently, they are partly resolved into uric acid, or urea, and partly excreted by the kidneys without undergoing any farther change.

Hippuric Acid has long been known to exist in the urine of herbivorous animals, and Liebig has lately shown that it is a normal constituent of human urine. Its composition is—$C_{18}\ H_8\ NO_5 + H\ O$. When benzoic acid is introduced into the stomach, it is excreted by the kidneys, in the form of hippuric acid. Liebig supposes that it is derived from some of the non-nitrogenous elements of the food, and that it exists in nearly the same proportion as uric acid. Dr. Golding Bird, however, believes that its quantity in health is not constant, and always, unless after the ingestion of benzoic or cinnamic acid, very much less than has been stated. As it is extremely rich in carbon, Dr. G. Bird suggests that perhaps the excretion of hippuric acid by the kidneys may be a means of compensating for a deficient action of the lungs and liver.

Colouring Matter of Urine. — The nature of this substance is involved in much obscurity, and it appears probable that two or more substances may be included under this name. Some recent researches of Scherer have shown that the colouring matter is extremely rich in carbon, of which it contains more than 58 per cent.; hence it is probable that the elimination of this material by the kidneys may be another means of compensating for a diminished functional activity of the lungs or liver. Scherer supposes that the colouring matter of the urine is the direct result of the metamorphosis of the blood-corpuscles.

Ammonia.—Heintz has recently proved that ammonia is a constituent of healthy undecomposed urine. By precipitating with chloride of platinum, he found that the quantity of ammonia varied from 2·16 to 2·19 parts in 1000 of urine. It exists, combined with uric acid, and probably in the form of a triple salt, with phosphoric acid and soda.

The fixed Salts of the Urine are those which remain after the organic and volatile ingredients have been removed by a red heat; they amount on an average to 138 grains in twenty-four hours. The *sulphates* of potash and soda are the most abundant; these are probably in part derived from the food, but the quantity of sulphuric acid in the urine is too great to be explained entirely in this way, and it is evidently in part derived from the metamorphosis of the tissues. Dr. Bence Jones* has recently shown that the sulphates are increased in acute chorea, and in intense delirium tremens. He attributes this to the unceasing muscular action which is common to these diseases, and the consequent rapid disintegration of muscular tissue; the oxidation of the sulphur which enters into the composition of the muscular tissue is accompanied by an increased discharge of urea. He finds a similar increase of the sulphates in cases of inflammation of the brain, which, as well as a simultaneous increase in the discharge of phosphates, he supposes to result from an unusually rapid oxidation of the cerebral tissues. Dr. Jones finds that the sulphates in the urine are increased by food, whether vegetable or animal, as well as by the administration of sulphur, or of sulphates of soda or magnesia; but they are not increased by exercise, nor by the administration of sulphuric acid, except in very large doses.

Some unoxidized sulphur exists in a state of unknown combination in the urine, for, after all the sulphates have been removed, sulphuric acid may be formed by igniting the residue with nitre. Professor Ronalds believes that from three to five grains of sulphur are thus daily excreted. Cystine, which is

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* *Medico-Chir. Trans.*, vol. xxxiv.

occasionally found in the urine as a product of disease, contains no less that 26 per cent. of sulphur.

The Phosphates are less abundant than the sulphates, but the salts are more various. Like the sulphates, they are partly derived from the food and partly from the disintegration of the tissues. Dr. Bence Jones has shown that they are increased in cases of inflammation of the brain, in consequence, as he suggests, of the rapid oxidation of the nervous tissue.* The phosphates are taken largely in both animal and vegetable food; but a part only of the earthy phosphates contained in the food is absorbed into the circulation on account of their insolubility; the remainder may be found in the fæces.

A small quantity of phosphorus exists in the urine uncombined with oxygen.

The *Chlorides* occur as chlorides of sodium and potassium. As these salts exist in the food and in most of the animal fluids, their occurrence in the urine is readily explained.

We are now prepared to understand the physiological office of the kidney, which may be briefly stated to be the separation from the blood of its superfluous water, together with certain solid materials, which are characteristic of the urine. The physiological import of the word secretion is nearly identical with its strict etymological meaning, namely, *separation.* We have seen that the most important and characteristic of the urinary constituents may be

* *Med.-Chir. Trans.*, vols. xxx. and xxxiv.

detected in the blood, where they accumulate when, from any cause, the excretory function of the kidneys has been suspended or impaired. Some of the excreta have been shown to originate in the elements of unassimilated food, while others result from the metamorphosis of the tissues, and their formation probably occurs at the points where the blood is brought into contact with the ultimate elements of the tissues. Both sources of excreta are independent of the kidneys, whose office, I repeat, is to separate and not to form the constituents of the urine.

A previous examination of the anatomical structure of the kidney is the best preparation for a right understanding of the functions of its different parts. There appears no reason to doubt the accuracy of Mr. Bowman's doctrine, that while the convoluted tubes, with their lining of glandular epithelium, are the agents by which the solid constituents of the urine (the urea, uric acid, &c.) are secreted, the watery portion of the secretion is chiefly discharged through the Malpighian bodies.

The convoluted tubes resemble, in all essential points, the secreting tissues of true glands, and especially in that particular which is the most constant and important, the character of their epithelial cells. These structures have already been fully described, and it has been shown that the cells belong to that class of epithelium which is characteristic of true glands, and by the agency of which all secretion is effected. There is much that is mysterious in the act of secretion, as in every vital process; but thus much appears to be well established; that certain cells exert a kind of affinity for particular materials which are conveyed to them by the blood, and in virtue of this affinity, the cells first abstract the materials from the blood, and subsequently discharge them into the ducts of the glands. The cells of each gland are endowed with the power of excreting certain products rather than others; the liver-cells secrete bile, and the kidney-cells urine. We are ignorant of the nature of this power, but we see clearly that it is associated with a peculiar form of cell. The normal appearance of the gland-cells is as peculiar and characteristic as are the physical and chemical properties of their secretions. The cells of the kidney and of the liver, while they are alike in all particulars which constitute them gland-cells, yet differ from each other as much as their respective secretions—as much as urine differs from bile. It appears, therefore, that there is an intimate connexion between the structure and appearance of the cells and the nature and composition of their secreted products.

There is a strict analogy, too, between the processes of ordinary nutrition and secretion, for as each tissue assimilates to itself those constituents of the blood which are fitted for its nutrition, so each kind of gland-cell may be said to feed upon the materials which constitute its secretion. The chief difference between the two processes consists in the fact, that, as a result of the nutritive process, the assimilated materials retain their position and help to build up the tissues, while the products of secretion are usually discharged from the body.

The manner in which the gland-cells discharge their contents into the ducts differs in different glands. The secretion of the sebaceous follicles is almost solely composed of the gland-cells, which are continually being cast off entire. In the secretions of some glands a variable number of entire cells may be seen floating in the liquid. This is the case with the secretions of the salivary and mammary glands. In healthy urine, however, no entire gland-cells from the kidney, nor even the *débris* of renal epithelium are ever visible. It will hereafter be seen that the appearance of renal epithelium in the urine affords unequivocal evidence of disease.*

It is probable that the gland-cells of the kidney are in a continual state of transition, that the old cells are liquefied and pass away with the urine while new cells take their place, and these, in their turn, pass off in a liquid form. The renal cells *in situ* may be seen more or less filled with their granular and solid contents, as the corresponding cells of the liver are seen to contain the colouring matters of the bile.

The cells to which is assigned the function of secreting the solids of the urine are, as before mentioned, those which line the convoluted tubes. We have seen that the straight tubes of the medullary cones are lined by an epithelium which, having none of the characters of gland-cells, approaches in appearance to the ordinary pavement epithelium; we there-

* The only microscopic objects which are visible in healthy urine are a few cells of pavement epithelium from the bladder or urethra.

fore conclude that these straight tubes are merely ducts for the transmission of the secreted products from the convoluted tubes into the pelvis of the kidney, and this opinion will be confirmed by a consideration of certain pathological phenomena to which attention will hereafter be directed.

With regard to the Malpighian bodies they are, in their anatomical structure and arrangement, as unlike, as the convoluted tubes are like, the structures which, in other glands, secrete the characteristic products from the blood. They consist, as we have seen, of isolated tufts of capillary vessels which lie uncovered on the deep surface of the basement membrane within the dilated ends of the tubes, while the delicate, transparent epithelial cells which cover that portion of the capsule contiguous to the tube, have none of the appearances which are characteristic of the gland-cells. To these bodies, therefore, as Mr. Bowman suggests, some other and distinct function is, with the highest probability, to be attributed.

The secretion of the kidneys differs from that of all other glands in the abundance of water which it contains; and that this water is eliminated by the Malpighian bodies, the singular position and all the details of the structure of these bodies render in the highest degree credible.

'It would be difficult,' as Mr. Bowman says, 'to conceive a disposition of parts more calculated to favour the escape of water from the blood than that of the Malpighian body. A large artery breaks up in a very direct manner into a number of minute branches, each of which suddenly opens into an assemblage of vessels of far greater aggregate capacity than itself, and from which there is but one narrow exit. Hence must arise a very abrupt retardation in the velocity of the current of blood. The vessels in which this delay occurs are uncovered by any structure. They lie bare in a cell from which there is but one outlet, the orifice of the tube. This orifice is encircled by cilia in active motion, directing a current towards the tube. These exquisite organs must not only serve to carry forward the fluid already in the cell, and in which the vascular tuft is bathed, but must tend to remove pressure from the free surface of the vessels, and so to encourage the escape of their more fluid contents. Why is so wonderful an apparatus placed at the extremity of each uriniferous tube, if not to furnish water to aid in the separation and solution of the urinous products from the epithelium of the tube?'

I have long been convinced of the essential accuracy of Mr. Bowman's paper, and this not only in its anatomical details, but in its physiological inferences. Nothing has contributed to this conviction more than the assistance which his doctrine has afforded me in my attempts to interpret the phenomena of renal diseases, and I believe that no one can study these diseases in the light of Mr. Bowman's anatomy and physiology without perceiving, that as they would be unintelligible without that assistance, so they are in a remarkable manner confirmatory of the physiological doctrines to which I have referred.

CHAPTER II.

THE CAUSES OF RENAL DISEASE.

WITH reference to the causes of renal disease it will be convenient to postpone for the present the consideration of those diseases which have a purely local origin, and which frequently arise from an entirely mechanical cause, such, for instance, as the diseased states of the kidney produced by calculi either in the substance of the kidney or in the ureter; the consequences of impediments to the escape of urine from the kidney, or of injury inflicted from without, by blows upon the loins. It will be well, too, to reserve for separate consideration the subject of cancerous disease of the kidney, since these diseased conditions have certain peculiarities by which they are distinguished from those morbid states of the kidney, the history of which I am now about to give.

Excluding from consideration those forms of disease to which allusion has just now been made, it will be found that all the causes of renal disease have this common feature—that *they tend to produce a morbid condition of the blood*, either by introducing some poison from without, or by interfering with the elimination of certain noxious matters developed within the body, by so far reducing the quantity of nutritive food that it is insufficient for supplying the waste of the tissues, and for enabling the blood to maintain its healthy composition, or, lastly, by some exhausting and depressing agency which lowers the vital energy and diminishes the power which the healthy body possesses of resisting and overcoming injurious influences whether originating within or without.

Proceeding, now, to the consideration of the particular causes; that which deserves the earliest notice is exposure of the body to cold and wet; since in itself it will probably suffice to produce disease in the kidney, and, in conjunction with other causes, it is a very fruitful source of mischief. Allusion has already been made to the vicarious action of the skin and kidneys, (p. 43.) The quantity of liquid which passes off by either means of exit is greatly influenced by the temperature of the external air, so that in the warm weather of summer the urine is comparatively scanty, and the cutaneous exhalation is abundant, while in a cold atmosphere these proportions are reversed. Under ordinary circumstances it is probable that these varying quantities of the renal and cutaneous secretion affect chiefly the watery portion of each, while those constituents which are peculiar to each secretion are comparatively uninfluenced; but when the surface of the body is suddenly exposed to cold, and especially when with the influence of cold is associated that of moisture, and when the exposure is long-continued and combined with fatigue, or when, the body being at rest, the counteracting influence of exercise is withdrawn;—under these circumstances it is probable that all the constituents of the cutaneous excretion are diminished, as a consequence of which they must either accumulate in the blood, or they must be eliminated by some other channel. That the proper cutaneous secretion must be diminished by cold is sufficiently evident from the pallor and shrinking of the skin, which results from the diminished afflux of blood produced by chilling of the surface — a condition obviously quite incompatible with the full and perfect discharge of its excretory functions, since it is an acknowledged fact, that, *cæteris paribus*, the amount of secretion by a glandular organ is directly proportioned to the quantity of blood which circulates through it. Bearing in mind that the materials of the various excretions are not actually formed by the organs which eliminate them; that carbonic acid is not formed by the lungs or skin, nor urea by the kidneys, but that these matters are being continually generated in the blood itself, or at the points of contact between the blood and the various ultimate tissues, and that the excretory glands are destined only to separate these products from the blood and so to discharge them from the body—bearing these facts in mind, it will be apparent that the immediate consequence of the more or less complete suppression of any secretion will be, that the constituents of the secretion will, for a time at least, and in a greater or less degree, accumulate in the blood. For even when there exists another gland in every respect fitted to eliminate the suppressed secretion, the blood being made the channel by which the materials are conveyed from the organ whose functions are suspended to that which is now called upon to assume a vicarious action, the transfer cannot probably be effected so promptly and completely, but that the blood will, for a time, contain an excess of these excrementitious matters. Now, the only case in which one excretory organ can perfectly discharge the functions of another, is where the organ is double and the secretion consequently identical. One kidney or one lung may, and often does, discharge the functions of both. But even in these instances of vicarious action in organs whose structure and functions are identical, the process cannot be suddenly effected without endangering and often destroying the life of the patient. Thus when the functions of one kidney are suspended by the sudden impaction of a calculus in the ureter, the urine is always very scanty, sometimes almost suppressed; and this is to be explained, not merely by the pain and the sympathy existing between the two kidneys, but by the fact that a double amount of urea and of the other urinary constituents is suddenly sent to the one gland; and in consequence of these materials being conveyed to the kidney more rapidly than they can be eliminated, they accumulate in the blood, the circulation through the kidney is retarded and its functions impeded: a chain of consequences which will be more fully explained hereafter. In process of time the kidney entirely adapts itself to its double duty, and it does so by increasing in bulk in direct proportion to the increase of work which has been imposed on it.

What has been said of the kidney is applicable, with certain modifications, to the lung. It sometimes happens that the function of one lung is suddenly suspended either by a rapid effusion, in acute pleurisy, or by perforation of the pleura, occurring in the course of tubercular disease of the lung. The immediate consequence of either accident, is very urgent difficulty of breathing, which may quickly end in complete suffocation. The degree of distress and the result of the struggle, will depend on the condition of the other lung. The more entire its freedom from disease, the greater the probability that by its more rapid and vigorous action, as indicated by the hurried movements of the chest and by the greater loudness of the respiratory sounds, it will free the patient from the danger of suffocation; so that he may live for weeks or months, or even, for years—the one lung still discharging the function of both.

The cases which we have now been considering, are different from those in which an excretory organ is called upon to eliminate from the blood, some materials which do not naturally form a part of its own proper secretion. In such cases the difficulty of a vicarious action, is much greater than in those instances where one organ strives to do the work of its fellow, as well as its own; and the effort to discharge its new function, is often productive of disease, commencing, as we shall see hereafter, in the secreting cells of the gland. At present, I am anxious only to point out the fact, that suppression of the cutaneous secretion is a frequent cause of such an alteration of the blood as produces disease in the kidneys. The cases of Revels (No. 15), and Hayden (No. 18), may be referred to as examples of disease in the kidney arising from exposure to wet and cold. Leaving the subject here, we shall revert to it when we come to the examination of the diseased organs.

Disease of the heart or lungs is not unfrequently associated with disease in the kidneys, sometimes as a cause and sometimes as a consequence. At present we are concerned only with its former relation. There are certain pathologists who teach that disease of the heart or lungs, may produce disease in the kidneys by a mode of action almost, if not entirely, mechanical; and, in proof of their doctrine, they state that the urine will be found albuminous, at first, from mere mechanical congestion of the kidney, consequent on impeded circulation through the heart or lungs; and that after this has continued for a longer or shorter time, the kidney undergoes changes of structure. They describe these two stages, the first as one of mere congestion, and the second as one of structural change in the organ, and both as consequences of a mechanical impediment to the renal circulation. I believe that as pathological science becomes more complete and accurate, such mechanical explanations of disease as are here referred to, will diminish in number, and that less importance will be attached to them. When we come to examine the structural changes which the kidney has undergone in these cases, we shall find them to be such as could no more be explained by a mere mechanical impediment to the circulation, than the products of a spinning or a weaving machine can be accounted for by reference solely to the action of the piston which sets the machinery in motion. The piston is an essential part of the machinery; but it acts through a long series of contrivances, all of which must be studied before the final results can be fully comprehended. Disease of the heart or lungs may, without doubt, be the first in a series of morbid actions which will end in disease of the kidneys; but the connexion between the diseases is less immediate and more complicated than is implied in any mechanical hypothesis. The kind of disorder which is most likely to produce renal mischief is, in the heart, disease on the left side, either of the aortic or mitral valves; and in the lungs, that distressing complication of emphysema with chronic bronchitis which is so common in this country during the winter season.* As a consequence of either of these diseases the respiratory function of the lungs is imperfectly performed, and the blood is changed in its composition, first, by containing less than the natural quantity of oxygen, and secondly, by containing an excess of carbonic acid, and, probably, of other excrementitious matters. And it is not to be supposed that in these respects alone the composition of blood is changed by deficient pulmonary respiration. For the blood being a living liquid, the very centre of life and of changes more active than occur in any other part of the body, the retention of excrementitious matters within it cannot

* I make no allusion here to the not unfrequent complication of tubercular disease of the lung with renal disease, because the connexion is probably of a different kind from that which exists in the instances here adduced, and it will be referred to hereafter.

rightly be considered as, simply, so much poisonous material added to the normal composition of the blood, but, rather, as a source of further changes more complicated than could be traced by any chemical analysis.* This is notoriously true of the morbid poisons which infect the blood in many diseases. A minute quantity of the small-pox poison inserted beneath the skin will rapidly pervade the whole system, changing the composition of the blood and multiplying itself to an indefinite extent. This is adduced merely as an example of progressive changes in the blood, which may not inaptly be compared to the phenomena of fermentation. It is not maintained that the phenomena in these cases are identical or even very strictly analogous; but they may serve as illustrations of a general doctrine, that morbid matters in the blood tend to produce other changes in the composition of that liquid; and this is true, not merely of matters which are entirely foreign to the blood, but also, though in less degree, of those materials, such as carbonic acid and

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* An instance of the inadequateness of chemical analysis, to the detection of subtle changes in the blood, is afforded by some experiments which were performed by Frerichs (*Die Bright'sche Nierenkrankheit*, p. 153.) After removing the hair from the skin of a number of animals (dogs, cats, and rabbits), he covered them with varnish or glue, and found that invariably, when the skin was entirely covered, the animals died within twelve hours. He carefully sought for the cause of death, but in vain. No change in the composition of the blood could be detected; yet it can scarcely be doubted that through the blood the suppressed cutaneous secretion had exerted its fatal influence. The only morbid appearance observed in the solid structures was congestion of the mucous membrane of the air-passages and intestines.

urea, which it normally contains in small quantities. So that when it is stated that disease may originate in the kidneys, as a consequence of impeded respiration, it is not implied that carbonic acid is the material which immediately excites the disease in the kidneys, since it is very probable that the blood may have undergone other changes as a consequence of the retained carbonic acid, and that these secondary changes have produced the renal disease.

What has here been said of the accumulation of carbonic acid is equally applicable to the case of all other excrementitious matters when retained in the blood, and I might have introduced these remarks while referring to suppressed perspiration; but it appeared desirable to adduce them here, with immediate reference to the heart and lungs, because the subject is one of much practical importance, and the connexion between the diseases of these organs and those of the kidney has often been misunderstood.* The subject will be again referred to when we come to examine the changes in the blood produced by disease in the kidney, and the dropsy and other consequences of those changes.

When the functions of the liver are impaired, so

* I am not prepared to deny the possibility of the urine being rendered albuminous by the mere mechanical impediment to the renal circulation, which results from obstructive disease of the heart or lungs; but I maintain that any explanation of the renal disease consequent upon cardiac or pulmonary disease, which excludes the consideration of the changes in the composition of the blood, induced by those diseases, must be very incomplete.

that bile accumulates in the blood, the kidneys secrete some of the colouring matter of the bile, and in doing so, their secreting cells are in some degree changed; but I have never seen serious disease of the kidney result from this cause. The subject will be reverted to when we come to examine the kidneys and the urine (chap. iii.)

Amongst the fever poisons, that which more frequently than any other excites disease in the kidney, is the poison of scarlatina. A careful study of the disease has convinced me that renal dropsy is not a necessary or a natural consequence of the fever poison; that, under favourable circumstances, the poison is eliminated entirely by the skin, and that it is only when its natural course has been interfered with by some disturbing influence, that it is diverted into other channels. The most frequent and influential of these disturbing causes is exposure to cold. The renal disease may come on at any stage of the fever, and its greater frequency during the period of convalescence, may, probably, be explained by the fact, that at that period the patient is more frequently exposed to cold, by which the process of desquamation and of elimination from the skin is checked, and the poison being thus driven inwards, is excreted, as we shall hereafter see, by a desquamative process in the kidneys. Since, then, exposure to cold may produce renal disease at any period between the first appearance of feverish symptoms and the final cessation of the cutaneous desquamation; and as a patient with a mild attack of fever is more likely to be exposed early to the injurious influence of cold; so dropsy occurs more frequently after such slight attacks than when the feverish symptoms are more severe. Thus, on the 30th June, a boy, five years of age, had a full eruption of scarlatina; the fever subsided very quickly, and on the 5th July—that is, on the sixth day—it was thought that he would be benefited by an airing on the river; and, accordingly, he was taken on a steamer to Woolwich. It was a fine day, but rather windy. When he returned, the glands of the neck were swollen, and on the following morning his face was dropsical; he complained of headache, was feverish and deaf, and the urine was high-coloured and scanty. When I saw him, on the 7th July, he had all the symptoms of acute renal disease, the urine being highly albuminous and bloody. The case was very tedious and troublesome; the more so, because the child's parents had, deeply rooted in their minds, the conviction that exposure to the open air was highly beneficial, and the injudicious management which originally excited the disease, contributed to make the cure more than usually difficult.

As every error has its opposite, so it is in the management of scarlatina, and, indeed, of all febrile diseases. While some attendants appear to imagine that patients cannot have too much air, there are others who, acting upon the notion that warmth is essential, raise the temperature by carefully closed doors and windows, large fires, and heaps of bed-clothes. Next to the opposite plan of early exposure to cold, I believe that this irrational mode of treatment is most likely to excite disease of the kidneys in the course of scarlatina; and that it is a very frequent cause of the disease amongst the poor, who live in small, dirty, and ill-ventilated rooms. The case of Elizabeth Stopforth (No. 4) affords an example of dropsy coming on under these circumstances. It is obvious that impure and hot air, by interfering with the functions of the skin and lungs, will add to the febrile disturbance and check the elimination of the poison; and so will increase the risk of other excretory organs, and especially the kidneys, being called upon to free the blood from its accumulated impurities.

Next in importance to temperature and ventilation is the influence of diet and medicine in either producing or preventing disease of the kidneys during the progress of scarlatina. Alcoholic stimulants appear to have a direct tendency to excite disease in the kidneys; for they often increase the febrile disturbance, and diminish nearly all the secretions, particularly that of the skin, which frequently becomes hotter and drier during their use; while the only secretion which is usually increased by them is that of the kidneys; so that the natural process of elimination by the skin is checked, at the same time that the diuretic action of the alcohol tends to divert the poison to the kidneys, and there to excite disease. The case of MacClement (No. 28) may here be referred to as an illustration of the danger sometimes attending the use of alcohol, when the blood contains poisonous matters. Doubtless there are cases of scarlatina in which it is quite necessary to give stimulants, but neither in this, nor in any other febrile disease should they be given without care and caution, for although, when judiciously administered, they are productive of great benefit; yet an indiscriminate use of them is highly injurious, by adding to the excrementitious matters in the blood, and checking the elimination of those which previously existed.

What has been said of the diuretic action of alcohol is equally applicable to all diuretic medicines; the tendency of which is to stimulate the kidneys, and so to excite disease in them by directing the poison towards them; whereas it is of the utmost importance to promote the action of the skin and bowels, and to permit the kidneys, as much as possible, to rest until the fever poison has been entirely eliminated. For the same reason, it is desirable to avoid the use of cantharides as a blistering agent in cases of scarlatina, on account of its well-known tendency to irritate and inflame the kidney.

The early administration of solid food, either in large quantities or of an indigestible nature, is another source of renal disease during the convalescence from scarlatina; for the admission into the blood of imperfectly digested materials, will add to the work of the excretory glands, and especially to that of the kidneys, and so will tend to excite disease in them.

In a certain number of cases of scarlatina, renal disease will occur, when it cannot be attributed to any of the disturbing influences which have been mentioned; but these cases are rare, and particularly so, if we exclude those in which there has been some previous disease or cachexia.

The poison of measles is an occasional, but not a frequent, cause of renal disease with dropsy and albuminous urine. In the appendix to chap. iii. there will be found a notice of two cases, both of which occurred in the same family.

One well-marked case of acute renal disease in a child, occurred in connexion with *erysipelas* of the head. The patient was under the care of my friend, Mr. Armitage. Another case occurred in the person of one of my friends, while he was house-surgeon of a hospital. After being much exposed to the poison of erysipelas, which was prevalent in the wards at the time, he was seized with symptoms of fever and slight sore throat; and after confinement to his bed for a week, he exposed himself to cold by riding out on horseback, without a great-coat, in the month of November. This was quickly followed by general dropsy with albuminous urine, from which he did not recover for several weeks, in consequence of more than one act of imprudence during the progress of the disease. It is possible, although there was no eruption, that the disease may have been scarlatina; but I agree in opinion with the patient, that as he had been much exposed to erysipelas, and not at all to scarlatina, the poison of the former disease had been the source of the mischief in his case. These instances will show the importance of avoiding exposure to cold, during the convalescence from erysipelas.

The same caution is necessary in the case of all acute diseases. I have, in two instances, seen disease attack the kidney during the convalescence from *typhus fever*. One of these, which terminated fatally, is recorded in chap. viii. (Case 25.)

On two occasions I have known acute renal disease occur after *rheumatic fever;* one of these terminated fatally, and the case will be found in chap. vi. (Case 21.) Under the circumstances of recovery from typhus or rheumatic fever, the blood must long remain in a condition far from normal; and until its healthy composition is restored, there will be some risk of disease in the kidneys—a risk which will be greatly increased by any untimely exposure to cold, or by errors in diet.

During the progress of chronic diseases, too, and especially such as are attended with great exhaustion, and impairment of the general health and nutrition, the sudden occurrence of renal disease is not an unfrequent accident. An example of this is presented in the case of Eliza Smith, æt. 21, who came under Dr. Budd's care in King's College Hospital. She had suffered much from secondary syphilis, and at the time of her admission, on the 26th November, 1845, she was very weak and emaciated, had cough with mucous expectoration and night-sweats, and very painful nodes on the shin bones. She soon began to improve under the use of iodide of potassium and a nutritious diet. In the early part of December symptoms of renal disease were first observed; she had frequent vomiting, and on the 16th December the urine was found to be scanty and very albuminous. The day before this she was seized with pleurisy on the left side. She continued to grow worse until the

11th January, when she died. The kidneys presented the characteristic appearances of recent acute desquamative nephritis; the left pleura was covered by seropurulent liquid, and there was recent lymph on the surface of the heart; the substance of the lungs was healthy.

The cholera poison, as is well known, generally affects the kidneys, and it excites in them the same kind of disease as is produced by the poison of scarlatina. The cholera poison, however, differs from that of scarlatina in being very quickly eliminated; so that if the patient survives the short but fearful struggle, the kidney, in most cases, quickly returns to a healthy condition. Cases 7, 8, 9, and 10, will serve as examples of the condition of the urine during life, and of the kidney after death from cholera.

Disease of the kidney, with albuminous urine, is very common in connexion with *purpura*. I have observed this in several instances. The case of Charles Fox (No. 5) is an example of this complication. In other cases of cutaneous disease, obviously associated with a morbid condition of the blood, it is by no means unusual to find disease of the kidney. The case of Lewis (No. 22) is an example of acute renal disease in connexion with an *ecthymatous eruption*. And the following case, from the *Medical Times* of May 22, 1847, is one, evidently, of acute nephritis supervening upon the suppression of an extensive eruption of *impetiginous eczema*. The case occurred in the Hospital Saint Louis, and is thus reported:—
'R——, æt. 27, a porter, was admitted into the hos-

pital on the 10th March. Some months previously, under the influence of circumstances which remained unknown, a scaly eruption showed itself on the body and limbs; warm baths were exhibited; the scales fell, and an eruption of impetiginous eczema appeared on the thighs, scrotum, and arms. The eruption was rapidly yielding to a mild antiphlogistic treatment, when, on the 12th April, œdema of the face, intense pain in the lumbar region, and suppression of urine were observed, together with a considerable degree of dyspnœa and febrile excitement. In the peritoneal cavity, a certain amount of effusion was also detected. The urine, which at first was altogether suppressed, was afterwards secreted, though very scantily, and was found to contain a large quantity of albumen. The respiration became more and more difficult, although auscultation of the chest betrayed the presence of no physical change; and after three days the patient died.'

The case of Mac Clement (No. 28) is a remarkable instance of acute and rapidly destructive disease of the kidney, in connexion with *boils and carbuncles* on the surface of the body.

The intemperate use of alcoholic drinks must be classed amongst the most frequent causes of renal disease, and especially when with this is combined the influence of a deficiency of nutritive food. For as each of these conditions is, in itself, sufficient to produce such a morbid state of the blood as will develope disease in the kidney, so, when combined, they are more than doubly influential. It is obvious that the effect of intemperance in producing a morbid state of the blood and impairing the nutrition of the body must be multiform. The secretions of the stomach are deranged, the appetite is impaired, and the digestive powers are weakened; so that the blood is deprived of its natural supply of nutritive material, and at the same time it is contaminated by a mixture of alcohol and imperfectly digested food. It is probable, too, that the mental worry and anxiety, with the restless nights, and sleep disturbed by fearful dreams and spectral visions, which are so constantly associated with intemperance and extreme poverty, will all contribute to develop the morbid tendency. Add to all these, the influence of exposure to cold and wet, and we have a combination of causes very powerful in the production of renal disease. The case of Lewis (No. 22) may be referred to as an illustration of the influence of intemperance; that of Ann Furze (No. 3) for the effects of privation and anxiety. In the case of Revels (No. 15) mental depression appeared to diminish his power of resisting the influence of cold and wet; and in the case of St. Ledger (No. 1) an irregular and scanty diet seems to have had a similar effect.

Another very fruitful source of chronic disease in the kidney is *the poison of gout*. It would be useless to occupy the time of my readers by lengthened arguments to prove that gout is a blood-disease; since all the phenomena of the disease clearly indicate such an origin, and can be explained on no other supposition. As to the nature of the gouty poison we know nothing. That it is intimately connected with the uric-acid diathesis is evident from the frequent occurrence of uric-acid sediments in the urine, and of urate-of-soda concretions in the joints and other parts of gouty patients. We are indebted to Dr. Garrod* for the very interesting discovery that uric acid, as well as urea, exists in *perfectly healthy human blood*, and that in gouty subjects the blood contains a great excess of uric acid. Dr. Garrod, however, 'does not wish to advance any hypothesis as to the cause and nature of gout, considering that many further researches should be made on the subject before a theory of the disease could be advanced with safety.' When we come to examine the condition of kidney which is found in connexion with gout, we shall see that it differs in no respect from other instances of chronic renal disease unconnected with the gouty constitution. Examples of disease of the kidney occurring in gouty subjects are afforded by the cases of Hewson (No. 11), Addis (No. 16), Hobday (No. 17), and the case of a tradesman (No. 14).

A disorder very closely allied to gout, and commonly associated with it, is *dyspepsia*, and this, too, deserves mention amongst the probable causes of disease of the kidney. We know that the products of imperfectly digested food are often eliminated by the kidneys in the form of lithate of ammonia; but this, and various other materials, such as the phosphates of lime, ammonia, and magnesia, being normal constituents of the urine, may be secreted, in excess, by the kidneys without exciting disease in them. It is pro-

* *Med. Chir. Trans.* vol. xxxi.

bable, too, that many of the abnormal products of dyspepsia,—as, for example, the oxalate of lime,—can be eliminated without producing renal disease; while others, in being secreted, give rise, in different degrees, to structural changes commencing in the secreting cells. The nature and explanation of these changes will be considered hereafter.* It may be well to guard what has here been said of dyspepsia as a *cause* of renal disease, by the counter-statement, that dyspeptic symptoms are amongst the most frequent *consequences* of that morbid state of the blood, which results from disease of the kidney.

There are many *occupations* which, in consequence of their compelling those who follow them to breathe an impure atmosphere, must be classed amongst the causes of renal disease. Tailors, compositors, and others, who habitually work in hot, ill-ventilated rooms, are frequent subjects of the disease. Amongst this class of patients it is difficult to estimate the separate influence of each cause of disease when, unhappily, many of them are exposed, at the same time, to several —excessive labour in ill-ventilated rooms, intemperance in drinking, an insufficiency of nutritious food, mental anxiety, &c.

Amongst the most serious and intractable forms of renal disease, are those which occur in connexion with *the scrofulous diathesis*. In such cases it is probable

* In chap. iii. there will be found an account of changes in the secreting cells connected with the long continued elimination of sugar by the kidney in diabetes: the admission of sugar into the blood being the result of a kind of dyspepsia.

that the kidney suffers, in common with other organs, from the morbid condition of the blood and the general impairment of nutrition. Renal disease often co-exists with scrofulous disease in other organs; not unfrequently with tubercular disease of the lungs, or with disease in the liver or in the bones. The case of Woodman (No. 20) is an interesting example of the co-existence of disease in the kidney, with a similar disease in the liver, and scrofulous disease of the hip-joint.

It is probable, as already suggested, that such instances of co-existing disease in more than one organ, are results of one common cause—viz., a general morbid condition of the blood. It is also probable that, in many instances, a disease in one organ will tend to develop disease in others, and thus, that, in some cases, the primary disease may be said to have caused those which were developed later. Thus, in the case of Woodman, the long-continued pain and discharge from the hip-joint, with all the train of consequences, including confinement to the house and the impossibility of taking exercise, may have greatly contributed to produce the disease in the liver and in the kidneys. The same observation is applicable to cases of pulmonary consumption, and to the probable influence which the exhausting purulent discharge and the impeded respiratory function may have, in exciting disease in other organs.

Again, in other cases, where there is a tendency to disease of a scrofulous nature, the kidneys may be the *first* organs to suffer. I have several times met with cases of scrofulous disease of the lymphatic glands and lungs which appeared to have been occasioned by the exhausting influence of venereal excesses, and more particularly by the sad habit of masturbation. The case of Stephen Gray (No. 26) is an instance of disease having such an origin, but making its appearance first in the kidneys, and, apparently, affecting no other organs. It appears, therefore, that all those influences which are known to develop the scrofulous diathesis, and which may lead to the co-existence of analogous diseases in the kidney, and in other organs, may act primarily upon the kidneys, and must, therefore, be classed amongst the causes of renal disease. This catalogue will include excessive labour, either mental or bodily, the influence of depressing mental emotion, intemperance of every kind, food deficient either in quantity or quality, neglect of exercise, cleanliness, and ventilation, exhausting diseases, and, lastly, a tendency to disease transmitted from parent to offspring; so that a child whose parents have had scrofulous disease of the lungs or liver, may manifest his inherited tendency by the appearance of an analogous disease in the kidneys. The greater number of the influences here enumerated, have already been alluded to as exciting causes of renal disease; but it appeared desirable to refer to them again in connexion with the scrofulous diathesis; since it is manifest that where there exists such a constitutional tendency, the disease will be developed by the influence of causes acting for a shorter period, and with a less degree of intensity, than would have sufficed to produce disease in a previously sound and healthy subject.

From a consideration of the conditions which have been referred to, as giving rise to disease in the kidney, it appears reasonable to conclude, that all the causes of renal disease have this in common; *that they tend to produce a morbid state of the blood.* And this conclusion, which the nature and circumstances of the causes alluded to, render in the highest degree credible and probable, will be supported by a consideration of the pathological changes which take place in the kidneys.

Chapter III.

ACUTE DESQUAMATIVE NEPHRITIS.

THAT form of renal disease for which I have suggested the name of 'Acute Desquamative Nephritis,'* is the one to which, for various reasons, it will be convenient first to direct attention. It occurs more frequently than any other form of acute renal disease, being, for the most part, associated with all the cases of what are commonly called acute inflammatory dropsy; whether as a consequence of scarlatina, or from whatever cause originating; and its history and pathology are comparatively simple and intelligible.

Before approaching the subject of the morbid anatomy and the pathology of the disease, it is desirable to study its symptoms and general history. We will commence, then, with the general symptoms of acute desquamative nephritis; of which affection the renal disease commonly associated with the dropsy which occurs in connexion with scarlatina, may be taken as a type.

In a large proportion of cases, the attack is ushered in by more or less of rigors or chilliness, followed by feverish reaction, with its usual attendants, a quick,

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* *Med. Chir. Trans.* vol. xxx.

and sometimes a hard and throbbing pulse, a hot and dry skin, a dry tongue, with thirst, loss of appetite, pain in the back and limbs, headache and restlessness. In some cases, frequent vomiting occurs at an early period of the attack. In most instances, dropsy is a very early symptom; the patient's attention, or that of his friends, being first arrested by an appearance of unusual pallor and puffiness of the face; the swelling soon becomes general, affecting the areolar tissue throughout the body, and one or more of the serous cavities; and thus constituting one of the most troublesome and serious symptoms of the disease. At the same time, the urine is found to be scanty, and occasionally almost, or even altogether, suppressed; it is dark-coloured from admixture with blood, the colour varying from a slight smoky to a deep blood tinge, and generally it is so highly albuminous as to become almost solid when boiled, or on the addition of nitric acid.* The specific gravity of the urine at this stage of the disease, varies considerably; in most cases it deviates very little from the natural standard; the deficient excretion of solids being compensated, as regards the specific gravity, by the large quantity of albumen and the relatively small quantity of liquid; so that, although in some cases the specific gravity is low, yet in perhaps an equal number it is as high as from 1020 to 1025, or even higher; but a comparison of the quantity, with the specific gravity, and a reference to the table before given (p. 45), will show that the daily

* The mode of testing for albumen is described in the appendix to this chapter.

excretion of solids is very deficient; and the deficiency will appear greater after removal of the albumen by coagulation and filtration, when the density will be reduced by four, five, or even seven units.* There is usually more or less of pain and tenderness in the loins; the pain is sometimes, but rarely, very severe, and it occasionally extends downwards to the inside of the thighs and to the testicles. There is frequent desire to pass the urine, and sometimes a degree of pain or scalding during micturition. There is often more or less of uneasiness and tenderness in the epigastrium, with flatulent distention of the stomach, especially after eating, and nausea and vomiting are of common occurrence. In some cases inflammation of one or more serous membranes, as of the pleura, or pericardium, or peritoneum, supervenes; or the respiratory function is impeded by an œdematous or inflammatory effusion into the air-cells or into the smaller bronchial tubes; or the headache, which is usually present from the commencement, becomes more severe, and is followed by one or more attacks of convulsions, from which the patient may recover, or they may be followed by coma and death.

When the progress of the case is favourable, one of the earliest signs of amendment is an increase in the quantity of urine. So that a patient who, for some days, has secreted only a few ounces of urine in twenty-four hours will begin to pass it more abundantly, of a lighter colour, of less specific gravity, and less albuminous. It is by

* Dr. Christison, *On Granular Degeneration of the Kidneys*, p. 47.

no means unusual for an adult, during the convalescence from an attack of acute nephritis, to pass from four to six pints of urine in twenty-four hours; and this increased flow will continue for several days, the urine being, at the same time, of an unusually pale colour, and its specific gravity as low as 1010 or 1012. After an interval, varying from a few days to a month, or even more, the secretion of urine is reduced to the normal amount; the sediment, which at first was abundant and of a dark, reddish-brown colour, diminishes in quantity, assumes a lighter hue, and at length ceases entirely; the natural colour of the liquid returns, and the albumen, which had been gradually diminishing, altogether disappears. The two last-mentioned changes—the return of the natural colour of the urine and the disappearance of the albumen—usually occur simultaneously; so that a practised observer may judge, with some degree of accuracy, from a glance at the colour of the secretion, as to its freedom from albumen; the urine having an unnaturally white appearance so long as the albuminous impregnation continues, and recovering its usual sherry tint when it returns to its normal composition.

At any time during the convalescence, there may be a temporary increase of blood and albumen, and a diminished secretion of urine, if from an error in diet or from imprudent exposure to cold the congestion of the kidneys be increased. In most cases the return of the urine to its normal condition has been preceded for some days by an entire disappearance of the dropsy, and all other symptoms of internal congestion. In many instances the pallor of the skin and lips, which usually appears simultaneously with the occurrence of the dropsy, remains for a considerable time after the disease has entirely ceased, showing the destructive influence which has been exerted upon the colouring matter of the blood; while additional evidence of the demand for new materials to repair the waste of the body is afforded by the voracious appetite which often torments the patient during the convalescence.

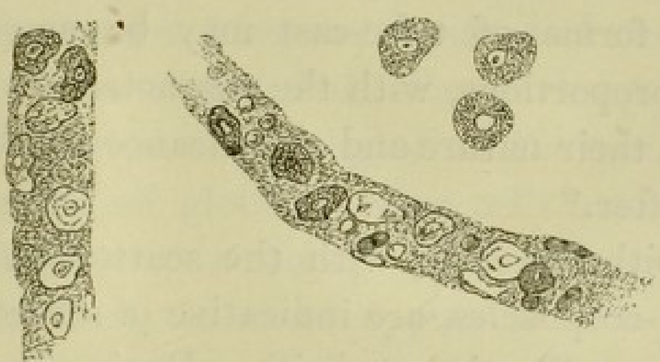
MICROSCOPIC CHARACTERS OF THE URINE.*

I have reserved until now, the description of the microscopic characters of the urine, in order not to interrupt the history of the general symptoms, and because it rightly occupies a position intermediate between these symptoms and the morbid anatomy, to which our attention must presently be directed. In the earlier stages of the disease the sediment, as already mentioned, is abundant, and deeply tinged with blood. On a microscopic examination it is found to be composed of coagulated fibrin, blood-corpuscles, cells having, for the most part, the characters of renal epithelium, and, occasionally, crystals of uric acid. Some of the fibrin is coagulated in irregular masses, having no definite form; this is always the case when the hæmorrhage has been abundant and rapid, so that much of the

* Some directions for making a microscopic examination of the urine will be found in the appendix at the conclusion of this chapter.

blood has escaped from the kidneys before it has had time to coagulate; but with these masses there will be seen numerous cylindrical bodies composed of fibrin, which, having exuded from the Malpighian bodies, has coagulated in the tubes, and escaping thence, presents solid cylindrical moulds of the interior of the tubes, in which are entangled blood-corpuscles and epithelial cells, which have been shed, by a process of desquamation, from the surface of the tubes. To the casts, thus characterized by the presence of recently formed and entire epithelial cells, I propose to give the name of *epithelial casts* (fig. 8). Their average

Fig. 8.



Epithelial casts and cells. Some blood-corpuscles are entangled in one of the casts.

diameter is about $\frac{1}{700}$ inch. Besides the blood-corpuscles and the epithelial cells entangled in the casts, there are many of these bodies scattered about the field; occasionally, too, there are some corpuscles smaller than epithelial cells, and, apparently, intermediate between these structures and pus-corpuscles; and with these there may be a few which have all the characteristics of pus, and which present the compound nuclei on the addition of acetic acid.

It is probable that these frequently originate in irritation of the mucous membrane of the bladder occasioned by the contact of morbid urine.

In most instances of acute desquamative disease, the urine contains some casts which differ in character and appearance from those before represented and described as epithelial casts. 1st. Some casts are composed entirely of blood; a representation of these, under the name of blood-casts, will be found in fig. 27, chap. xi. 2nd. Some casts of larger size, about $\frac{1}{500}$ inch in diameter, and having a wax-like appearance, are represented in fig. 12, chap. iv.; and 3rd, h. 185 some casts, about half the diameter of those last mentioned, are shown in fig. 23, chap. vi. Each or all 35-2 of these forms of tube-cast may be associated, in variable proportions, with the characteristic epithelial casts, and their nature and significance will be pointed out hereafter.*

The epithelial casts, with the scattered epithelium and blood-corpuscles, are indicative of a recent attack of acute desquamative nephritis. During the progress of the disease, the sediment in some degree changes its characters. Thus a portion of the blood and the epithelium having remained for some hours, or even days, in the tubes, before it is washed out, and becoming more or less disintegrated, will present somewhat of the appearance of the granular casts, which are characteristic of a chronic form of disease to be described hereafter (chap. iv.); but the means of diagnosis are sufficiently simple. In the acute disease, so long as

* A reference to the earliest observation of tube-casts in the urine will be found in the appendix to this chapter.

the desquamative process continues, the 'granular casts' are mixed with epithelial casts and blood-corpuscles,* which clearly indicate the character of the disease; and the cessation of the desquamation is quickly followed by the disappearance of all sediment, a diminution of the albumen, and a subsidence of the more urgent symptoms; while in cases of chronic desquamative disease, the granular casts, unmixed with entire epithelium, or with epithelial casts, are continually present, and the condition of the urine varies but little from day to day.

There is yet another modification of the casts and epithelium, which requires particular notice. Very frequently, after an attack of acute desquamative disease has continued beyond a period of two or three weeks, some of the epithelial cells which are scattered through the urine, or entangled in the casts, will be seen to contain oil globules, some cells having two or three globules within them, and others being quite filled with them, so as to appear almost black; at the same time some of the casts will be found to have oil globules on their surface; these, probably, having escaped from some of the ruptured cells. These appearances are represented in fig. 24, chap. vii. p 377

When I first observed this condition in a case of acute renal dropsy, I was apprehensive that the kidneys were undergoing fatty degeneration, and I, accordingly, gave a very unfavourable prognosis, which the result of the case, happily, did not verify.

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* In the fourth chapter there will be found an explanation of the comparative rarity of hæmaturia in cases of *chronic* renal disease.

The case to which I allude is that of St. Ledger (No. 1), and its history well illustrates the general remarks which I have to make upon this very important point.

The result of my observation with reference to this matter is, that in children, oil very rarely appears either in the cells or in the casts during an attack of acute desquamative disease; in adults, on the contrary, very frequently more or less oil may be seen, as already mentioned, when the disease has continued beyond a period of two or three weeks. So long, however, as the oily casts and cells are few in comparison with the epithelial casts, and the scattered epithelium free from oil, there need be no apprehension of an unfavourable result; but if, on the contrary, while the urine continues highly albuminous, the epithelial casts and cells diminish in proportion to those which contain oil, until, at length, nearly all the casts have more or fewer oil globules on the surface, and the greater number of cells are more or less distended with oil; under these circumstances there will be much reason to fear that the kidney is passing into a state of fatty degeneration—a transition not less serious in its nature and consequences than that from acute pneumonia or bronchitis to a tubercular deposit in the lung. The case of Charles Cowdry (No. 25) may be referred to as an illustration of the point in question.

Whenever, then, oil makes its appearance during the progress of a disease which commenced with the symptoms of acute desquamative nephritis, we shall watch the case with much interest and with some degree of anxiety; but in by far the greater number of instances we shall have the satisfaction of observing, that, after a variable interval, the oil diminishes, and at length entirely disappears, together with all other diseased products, and the urine regains its normal composition. The case of St. Ledger (No. 1) may be again referred to as a good illustration of this favourable result.

The deposit of uric acid, which has already been mentioned amongst the appearances observed in the urine of acute desquamative nephritis, is not, of course, characteristic of the disease, but it deserves a passing notice on account of its frequent occurrence. I have seldom seen a case, whether in children or in adults, in which there has not been such a deposit, and often a very copious one. It usually appears, first, after the extreme congestion of the kidney has been relieved, and when the secretion is becoming more abundant; and it often continues at intervals, and more or less abundantly, until the patient is completely restored to health. In this abundant deposit of uric acid, the urine of acute nephritis differs remarkably from that of some other forms of disease, and particularly from that of fatty degeneration, which seldom has an abundant sediment of any kind, and very rarely deposits uric acid.

Morbid Anatomy.—When an attack of acute desquamative nephritis has terminated fatally, the appearances presented on a post-mortem examination are usually the following:—

Both kidneys are diseased, and commonly in an almost equal degree. They are enlarged, and their weight is increased, so that each kidney may weigh from five to eight ounces, and in some cases even more. Their surface is smooth, and the capsule readily peels off. Their vascularity is usually much, but somewhat irregularly, increased. In some patches the capsular surface is quite pale, as if from a deposit of new materials, while in other parts the vessels are greatly gorged, their colour varying from a bright scarlet to a slate colour. There is considerable variety in the relative proportions of the exsanguine and the congested portions. In some specimens the vessels are everywhere much gorged, while in other instances there is so little appearance of vascularity that the cortical substance might, perhaps, be described as anæmic. The lobular markings* in the paler portions are indistinct, while in the more congested parts they often appear larger and coarser than natural. Very commonly there are some sanguineous spots on the surface, some of which are round, while others have an irregular form; the former of these were always described as enlarged Malpighian bodies, until Mr. Bowman demonstrated that they were produced by an extravasation of blood into the convoluted tubes.† (Fig. 9.) On section there appears a very marked distinction between the

Fig. 9.

Malpighian body and convoluted tube filled with blood, which has been extravasated from the Malpighian capillaries; forming one of the red spots as seen by the naked eye in the cortical substance. Magnified 45 *diameters.*—Med. Chir. Trans. vol. xxix. pl. 1.

* See ante, p. 9.

† *Phil. Trans.* 1842.

cortical and the medullary portions. The former presents the same irregular mixture and variable proportion of congestion and anæmia, as already described on the capsular surface; the ecchymosed spots, too, are visible here as on the surface, sometimes taking a linear course, more particularly near the basis of the medullary cones. The consistence of the gland varies. In adults and young persons it is commonly rather firmer than natural; while in aged persons the kidneys often partake of the soft and yielding character of the other glandular organs. The medullary cones are usually of a dark colour, from venous congestion; the bodies of the cones appear compressed by the swollen portions of the cortical substance which pass between them, while the bases are expanded and spread out into the cortical portions, thus, as suggested by Rayer, having the form of a wheat-sheaf.

The mucous membrane of the pelvis, and occasionally that of the ureter, is more or less congested.

The bladder often is quite empty, or it contains a few ounces of urine, which is highly albuminous, and presents other appearances, which have been already described as characteristic of the urine secreted during the progress of the disease. The mucous membrane of the bladder is usually congested, the extent and degree of congestion varying considerably in different cases.

Such are the appearances visible by the naked eye in the urinary organs. There is, besides, more or less dropsy of the areolar tissue throughout the body, and frequently of one or more of the great serous cavities.

The liquid in the cavities may be simple serum, or it may be mixed with lymph or pus, the result of an inflammatory process; and in such cases there will be increased vascularity and other marks of inflammation of the membrane which secreted the morbid product.

The liver sometimes appears enlarged, as if from a recent interstitial deposit.

The lungs are commonly gorged with frothy and sometimes with bloody serum, and their substance is often more or less extensively carnified or hepatized.

There is seldom much appearance of structural change within the cranium, even in those cases which have presented unequivocal cerebral symptoms during life, and which have terminated with convulsions or coma. There may be some increase of liquid beneath the arachnoid and in the ventricles, with a degree of congestion of the membranes or of the cerebral substance, as indicated by an increase in the number and size of the red points visible on the surface of a section, and in some rare cases there may be an effusion of lymph or pus; or there may be none of these conditions, nor any appearance which can be considered morbid.

CHANGES IN THE BLOOD.

An examination of the blood in this acute form of disease, shows a defective proportion of albumen and a diminished density of the serum. The altered condition of the serum was first noticed by Dr. Bostock. The density of the serum, which ranges naturally between 1029 and 1031, is, according to Dr. Christison, seldom above 1022, and often as low as 1020, or even lower. The loss of density is greatest when the urine has been most albuminous, and is probably occasioned by the escape of serum through the kidneys. The solid contents of the serum are reduced from 100 or 102 in 1000, to 68, 64, or even 61; the reduction affecting, as Dr. Christison believes, equally the albuminous and the saline contents.

The fibrin is sometimes in excess, especially when secondary inflammation of the serous membranes has existed before death. The hæmatosin or colouring matter is said to undergo little or no diminution when the disease is quite recent, although, after a short time, the decrease is very rapid. Dr. Christison adopts as the average proportion of hæmatosin for the male sex, 1335 parts in 10·000; and he found that in the first week of the disease it was 1339 in a stout man not previously bled. In another man, also of stout habit, one month ill, but once or twice previously bled, it was 1111; in another powerful man, five weeks ill, and once before slightly bled, it was 1046; in a stout porter, ill probably for two months, and once before moderately bled, it was 955; in a lad, two months ill, and recently bled largely, it was 564; and in a young man, ill for three months and a half, subsequent to scarlatina, and who had never been bled before, it was only 427.

The decrease of colouring matter appears, therefore, to be less rapid at the commencement, than the extreme pallor of the patient, which very quickly occurs, would seem to indicate; and it is probable that the blanched appearance of the skin, is partly occasioned by the quantity of water in the blood, and in the subcutaneous tissue. But when the disease has been of longer duration, the diminution of the colouring matter is very great.

Besides the change in the proportion of its normal constituents, the blood contains urea in large quantities; the same material being also found in the various dropsical and inflammatory effusions. The fact of the impregnation of the fluids by urea, was first announced by Dr. Christison, in a paper published in the *Edinburgh Medical and Surgical Journal*, October, 1829. Dr. Rees* has detected urea in the milk of a patient affected with disease of the kidney.

MICROSCOPIC APPEARANCES IN THE KIDNEYS.

Having now noticed, generally, the morbid appearances associated with the renal disease, we will return to the kidneys, and, after a minute examination of their structural changes, we shall pass on to the consideration of the pathology of the disease.

A microscopical examination of the kidneys shows that the disease affects chiefly the cortical portion of the gland, and that the morbid deposits are mostly limited to the interior of the convoluted tubes. Most of these tubes are found to be unnaturally opaque, in consequence of being filled by epithelial cells, which have been formed within them, and thrown into their cavity. The tubes are crowded with these cells in

* *On Diseases of the Kidney*, p. 46.

different degrees; some being fully distended, while in others there is little evidence of the desquamative process having occurred; there being only a single layer of epithelium on their walls, and this, either differing little from the normal appearance, or, perhaps, being unnaturally opaque and granular in texture. The most crowded tubes will usually be found in those parts which, to the naked eye, appear pale and anæmic. Some tubes appear to be rendered more opaque by the effusion of the coagulable constituents of the blood amongst the epithelial cells; in which case the addition of acetic acid clears the tissues and facilitates their definition; so that a tube which had previously presented only a confused, granular, and opaque appearance, may be seen to be filled with epithelial cells which have been shed into its cavity.

Besides the crowding of the tubes with epithelium, additional evidence of the kidney having been the subject of the desquamative process, is afforded by the numerous epithelial cells which are scattered about the field, when a portion of the kidney which has been scraped or torn with needles, is subjected to microscopic examination; the number of detached cells being, in such cases, very much greater, than when a portion of healthy kidney is subjected to the same process. Frequently, in the examination of the tubes, a portion of their contents being squeezed out, presents exactly the appearance of the *epithelial casts* which have been described as existing in the urine.

It has already been intimated (p. 94) that the red spots visible on the capsular surface, and on a section, are composed of tubes filled with blood; some of which, having been recently effused, retains its bright red colour, while, in other instances, where it has remained for a longer time in the tubes, it is more or less disintegrated and granular, and has a yellowish or brownish hue.

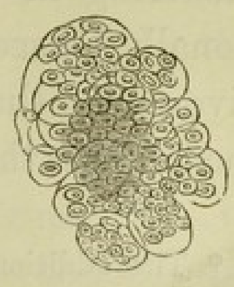
In some of the tubes the epithelium will be found to contain oil in minute quantities, and not exceeding what may often be seen in kidneys which are, apparently, quite healthy. This, therefore, is neither an essential nor an important part of the morbid anatomy of the disease under consideration.

Many of the straight tubes of the medullary cones appear quite normal, while others are opaque and filled with cells, more or less disintegrated, which seem to have been washed into them from the convoluted tubes. These abnormal materials in the straight tubes have none of the appearances which would indicate that they are the modified epithelium of the tubes which contain them; and when a favourable opportunity occurs for examining the epithelial lining of these tubes, it is generally found to present a natural appearance, or to be only so far changed, as would be accounted for by the passage through the tubes of an abnormal and irritating secretion.

The examination of the Malpighian bodies very naturally follows that of the tubes with which they are intimately connected. Before the structure and functions of these bodies had been accurately determined, it was customary to assign to them the chief agency in all the morbid changes of the kidney; and Bright's disease was sometimes vaguely pronounced to be an 'inflammation of the Malpighian bodies.' Now, happily, since Mr. Bowman has placed the anatomy and physiology of these bodies in so clear a light, it is not difficult to speak with precision of the pathological changes which they undergo. At present we are concerned only with the changes which occur in the acute form of disease, now under consideration.

The slightest departure from the normal condition, consists merely in an increased fulness of the capillaries: an engorgement with blood which appears of a bright red colour, as seen through the capillary walls. The Malpighian bodies, in this condition of simple engorgement, appear to the naked eye like minute, bright red grains. But when there has been acute desquamation, with an albuminous condition of the urine, the greater number of the Malpighian bodies present the following appearances. As seen by the naked eye they do not appear red, but they may be distinguished from the surrounding tissues by having a lighter colour and a less opaque appearance. Under the microscope they have the appearance which is represented in the accompanying figure.

Fig. 10.



Malpighian tuft. The vessels thickened, and the blood-corpuscles within them appearing magnified.

The capillaries at the first view, seem to be bloodless, and to have small cells upon their surface; but on a careful examination these are found to be blood-corpuscles modified in appearance by being seen through capillary walls, which have been rendered thick and opaque by the transudation through them of an albuminous or fibrinous effusion. The surface of the capillaries often appears rough and very finely granular, as if from the coagulation upon them of some of the materials which have escaped through their walls, but I have rarely seen any organized effusion upon them or within the Malpighian capsule. The corpuscles usually form a single row in the canal of the capillary; they often present a dot in the centre, and they differ from the ordinary appearance of the blood-corpuscles, chiefly in being somewhat larger and of a lighter colour. That they are blood-corpuscles in the canals of the capillaries is, I think, unquestionable; but it is less certain whether their modified appearance is entirely due to the opacity and thickening of the capillary wall, or whether the corpuscles themselves have undergone some change. I believe that the first-mentioned condition is the chief, if not the sole, cause of the appearance in question.*

In addition to the changes already mentioned as occurring in the Malpighian bodies there may occasionally be seen one in which, the capillaries having given way, the blood has escaped into the capsule, and thence into the tube, thus forming the spots of extra-

* The addition of acetic acid to a healthy Malpighian body, produces the same change in the appearance of the vessels and the blood-corpuscles, as that which results from acute congestion and the consequent transudation of serum through the coats of the vessels.

vasation which have been already alluded to (fig. 9, p. 94). In whichever of the before-mentioned conditions the Malpighian bodies are found to be, I have never seen them decidedly enlarged or dilated. This is a point which is very easy of observation, since the bodies are readily defined, on account of the contrast of their whitish and semitransparent appearance with the dark-coloured and opaque tubes; the former being free from deposit, and the latter gorged with their accumulated contents.

In describing the condition of the Malpighian bodies, I have necessarily spoken of a portion of the vascular system of the kidney, and a few additional observations upon this subject will suffice.

The kidney affected by a recent attack of acute nephritis, is more readily injected than when it has been the subject of any other form of disease, and a careful injection will generally fill, more or less completely, the entire vascular system. The parts which are less perfectly injected will be those patches which, before injection, appeared exsanguine, and which have been already described as consisting of tubes greatly gorged by their accumulated contents, where the intertubular vessels appear to be compressed by the surrounding swollen tubes. In most instances a microscopic examination of thin uninjected sections, will afford more exact and valuable information as to the state of the bloodvessels, than can be obtained by an inspection of injected specimens. Both methods of examination, however, have their advantages, and neither should be neglected. The result of the examination is, that in acute nephritis all the vessels are pervious. The arteries are congested, but present no structural change in their walls. The Malpighian capillaries are, in the early stage, gorged and transparent, but afterwards their walls become opaque and thickened, apparently from the transudation of serum through their coats, and probably from the coagulation of some materials upon their surface; in consequence of this change in the coats of the vessels, the blood-corpuscles within them have a modified appearance, as already described. The intertubular capillaries present no marks of structural change, and appear to contain less blood than in the healthy kidney. The branches of the renal vein are healthy, but occasionally they have coagula within them. It has already been mentioned, that the veins in the medullary cones are gorged, probably in consequence of retarded circulation, produced by pressure from the swollen cortical substance lying between the cones. The congestion of the mucous membrane of the pelvis and ureter has also been alluded to, and will presently be explained.

PATHOLOGY OF THE DISEASE.

Having now examined the morbid anatomy of acute desquamative nephritis, we are prepared to enter upon the subject of the pathological interpretation of the various conditions, which our anatomical investigations have revealed to us. In the first place, it will assist us to comprehend the whole subject, if we make some general observations illustrative of the proposition which we shall adopt as a central truth—viz., that *all the changes of structure commence in the secreting cells of the gland, and are the result of an effort made by the cells to eliminate from the blood some abnormal products—some materials which do not naturally enter into the composition of the renal secretion.*

Allusion has already been made to the physiology of secreting cells;* and it has been shown that the cells of the different glands have characteristic appearances, which render it quite easy for a practised observer to distinguish them from each other. The cells of the liver, for instance, have a very different appearance from those of the kidney. It is quite evident, too, that their appearances are not more diverse than their vital powers. The cells of the kidney have the power of secreting urine, while those of the liver secrete bile. And although, from an examination of the cells, the physiologist could not have predicted what would be the nature of their secretions, yet he rightly concludes that there is an intimate relationship between the structure and appearance of the cells and the nature and composition of their secreted products; so that he learns to attribute to a cell having certain characteristic appearances, the mysterious vital power of secreting the constituents of urine; while with a cell having certain other appearances he associates the power of secreting bile.

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* Page 56 *et seq.*

The next point which it is important to observe is, that the cells of each gland, besides the constituents of their own proper secretion, have also the power of separating from the blood certain materials which do not form a part of their normal secretion. It is well known, that many salts and many odorous and colouring matters, derived from the vegetable and animal kingdom, when introduced into the blood through the stomach, are eliminated by the kidneys; and the separation is effected so quickly and so completely, as to justify the belief, that the materials in question are secreted by the renal cells with as much facility as those which constitute their own proper secretion. In regard of some of these materials, it appears in the highest degree probable, that they may be secreted by the kidneys for a long time and in large quantities, without producing any perceptible change in the structure of the gland, or any other modification of the urine than the mixture with it of the salt or other foreign substance, with the addition, perhaps, of a certain quantity of water, which is required to keep the materials in solution. Whether any matters, not being constituents of healthy urine, can be secreted by the kidneys without producing some slight modification of the secreting cells, may perhaps admit of doubt; but the effect upon the cells is not commonly so injurious, that the physician need hesitate to give his patients for weeks, or even months, consecutively, such medicines as iodide of potassium, although he knows that this new material is continually being secreted by the renal cells, and so mingled with the urine.

It is important, however, to observe, that there are some materials which, when secreted by the kidneys in moderate quantities, and for a short time, appear to lead to no injurious consequences, may yet produce very decided changes of structure, after the long-continued secretion of the same materials in larger quantities. We have an instance of this, in the secretion of sugar by the kidneys in diabetes. It is now a well ascertained fact, that this disease consists in an imperfect digestion and assimilation of certain alimentary materials, as a consequence of which, the sugar which is formed in the stomach and intestines enters the blood, and is thence removed by various secretory organs, but chiefly by the kidneys. The sugar is a powerful diuretic, its passage through the secreting cells being accompanied by a flow of water from the Malpighian bodies, sufficient to keep it in solution. It can rarely happen, that an opportunity offers for examining the kidneys in the early stage of diabetes, so as to ascertain the condition of the cells at that period; but we know that for many months, several pints of urine will be secreted in the day, and this, without any evidence of the slightest imperfection in the discharge of the functions of the kidney. It is highly probable, however, that from the commencement, the secretion of sugar is accompanied by changes in the appearance of the cells; and after the long continuance of the disease these changes are very decided. In two cases of death from diabetes, I found the convoluted tubes of the kidney remarkably opaque, and having a yellowish tinge, the cells being also opaque, from containing a large quantity of finely granular matter with oil. In one case the urine had been albuminous and contained granular casts; of the urine in the other case I have no information, except that it was saccharine. The appearance of the gland-cells in the two cases was very similar, and was doubtless connected with the continued secretion of sugar. An albuminous condition of the urine, with more or less of structural change in the kidney, has, as Dr. Christison* remarks, been observed to occur so frequently in connexion with diabetes, that their concurrence can scarcely be considered as altogether accidental. The probable explanation of the phenomena is, that the long-continued secretion of sugar by the kidneys modifies the gland-cells, effecting a change in their appearance and in their vital endowments, so that in adapting themselves to the secretion of sugar, they become more or less unfitted for eliminating the constituents of their own proper secretion. This effect of the secretion of entirely new materials by the gland-cells, is no more than might have been inferred, *à priori*, from a consideration of the physiology of secretion, and of the specific characters which mark the cells, no less than the secreted products of each gland.

We have another illustration of the effect upon the secreting cells of an effort to eliminate new materials, in cases of jaundice. When, from any cause, the functions of the liver are so imperfectly performed as to allow of the bile accumulating in the blood, the urine

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* *Library of Practical Medicine*, vol. iv. p. 253.

is found to be deeply tinged with some, at least, of the constituents of the biliary secretion; and on a microscopical examination of the urine, we find the renal secreting cells in variable numbers, some being scattered, while others are entangled in moulds of the kidney tubes, and all of them coloured by the bile contained within them. When we have an opportunity of examining the kidney after death in these cases, we find the tubes deeply tinged by the bile contained in their secreting cells, and some tubes are nearly or quite filled with cells which have been thrown off, while others have been formed upon the basement membrane beneath them. Thus it appears that when the blood circulating through the kidney contains an excess of bile, the renal cells, in striving to eliminate these materials, become deeply tinged by it, and many of them are so far modified, as to be shed by a process of desquamation.

In the instances here adduced, of a change in the structure of the renal cells effected by the secretion, in the one case, of sugar, and in the other of bile, we have tolerably conclusive evidence as to the nature of the materials which have modified the cells. In many cases, however, we know nothing certain as to the nature of the material; and the evidence that there is some *materies morbi* which excites the renal disease is derived—1st, from a consideration of the circumstances under which the disease occurs. These have been referred to at some length in the preceding chapter, where an attempt was made to establish the proposition, that *all the causes of renal disease have this common* *feature, that they tend to produce a morbid condition of the blood.*

2nd. We gain additional evidence upon the point in question from analogy. We know that during the process of normal secretion, there is no visible shedding of secreting cells (see p. 58); but we have seen that certain materials foreign to the renal secretion, while they are passing through the gland-cells, so modify the process of secretion and of cell-growth, as to give rise to a desquamation of cells from the renal tubes. And this observation will suffice to show the probability that, in other cases, a like process of desquamation results from a similar cause—viz., an elimination of some morbid material by the renal cells. When, therefore, a patient has been exposed to one or more of the influences alluded to in the preceding chapter, as tending to produce a morbid condition of the blood, and when the urine presents the signs of the desquamative process occurring in the kidneys, there can be little doubt that this desquamation is the result of an effort to eliminate some of the abnormal materials, which have either been introduced into, or developed within the blood.

The reader who has attended to the preceding detail of facts and inferences, will have no difficulty in perceiving their applicability to the pathological explanation of the morbid changes, produced by desquamative nephritis.

It is assumed, that the blood being in a morbid state, whether from the poison of scarlatina, or from any other of the various causes alluded to in the preceding chapter, an effort is made to eliminate the noxious matters by the secreting cells of the kidney. The cells, in striving to separate the strange materials, become modified in their action and nutrition, and being rapidly thrown off into the tubes, are thence removed by the current of liquid, and appear in an entire form in the urine. Meanwhile the process of secretion is checked, and this, probably, in two ways. 1st. It is likely that when the cells are engaged in separating any new material, which so far modifies them as to lead to the process of desquamation, they perform their functions less rapidly and completely than under ordinary circumstances, and, consequently, that the act of secretion receives a check from the moment that any material reaches the cells which requires this modified action — a retardation of the function of secretion which may be illustrated by the check given to the electric current, when, in one of the cells of a battery, materials having less affinity for each other are substituted for more active and efficient elements.*

2nd. When the desquamative process has resulted, as it soon does, in the engorgement of many of the tubes with their accumulated contents, it is evident that in these tubes the process of cell-growth and of secretion must be greatly retarded, if not entirely arrested.

The next point to be observed is, that, together with impeded secretion, there is, as a necessary con-

* This, be it understood, is offered merely as an illustration, and not in the belief that the kidney is a galvanic battery, or the process of secretion an electrolytic one.

sequence, retarded circulation. This subject is fully discussed in connexion with that of chronic inflammation of the kidney (chap. iv.), to which the reader may refer. In this place it will suffice to state, briefly, that the process of secretion being interfered with, in the manner already described, and the blood, consequently, being imperfectly purified and freed from its excrementitious matters, the circulation through the intertubular capillaries is impeded, and the vessels which lie behind these, in the course of the circulation —the Malpighian capillaries and the arteries—become distended.* Serum now escapes freely from the gorged Malpighian capillaries, and mixing with the urine, renders it albuminous, while the coats of the vessels begin to assume the opaque and thickened appearance before alluded to. Together with the serum, there is a transudation of fibrinous material, which coagulates in the tubes, entangling on its surface some of the desquamated epithelial cells, and thence it escapes with the urine, in the form of the epithelial casts which have been already described. Further, some of the over-distended Malpighian capillaries, give way under the pressure to which they are subjected, and their contents escape into the tubes, some of the blood-corpuscles becoming entangled in the epithelial casts, and

* It is probable that the circulation through the intertubular capillaries is, in some degree, impeded by the engorgement and dilatation of some of the tubes, and the consequent mechanical pressure upon the vessels which surround them; but the influence of this cause, which I very much over estimated in my first communication to the Medico-Chirurgical Society, (see the 29th volume of the *Transactions*,) I now believe to be comparatively slight.

others being scattered through the urine, and contributing to form the dark-red sediment before described.

In describing the morbid anatomy of the disease under consideration, mention was made of the patches of congestion which are commonly found in the mucous membrane of the pelvis of the kidney, as well as in the ureter and bladder. These appearances are, probably, the result of irritation produced by the contact of morbid urine with the parts in question, and they are associated with the frequent micturition and other signs of irritability of the urinary organs, which are so commonly present during the progress of the disease. This secondary influence of morbid urine upon the tissues over which it passes, is one of considerable interest.

Simultaneously with the before-mentioned marks of impeded circulation and extreme vascular congestion, the urine is very scanty, and its constituents are, more or less, retained in the blood, as a consequence of which the capillary circulation throughout the body is impeded; hence the quick and throbbing pulse, with general febrile excitement, dropsical effusion, and, in some cases, inflammation of the serous membranes or other parts, or disorder of the cerebro-spinal functions.

When, under favourable circumstances, the morbid poison, which excited the renal disease, has been entirely eliminated, the desquamation of epithelium ceases, and the process of secretion again becomes normal, the blood is freed from its retained and accumulated excrementitious matters, the circulation through the kidney and throughout the body becomes free, the urine ceases to be albuminous, and the dropsy and other consequences of the poisoned condition of the blood disappear. We have already seen that the urine during the convalescence becomes abundant, and contains an increased proportion of liquid; the Malpighian bodies being, apparently, excited to profuse secretion of water by the stimulus of the desquamated epithelium which has accumulated in the tubes. This copious effusion of water is, probably, a reflex phenomenon, analogous to that of the rush of tears over the eye, in obedience to the stimulus of a foreign body on the conjunctiva. The purpose of the flow, too, appears to be the same in both cases—viz., to wash away materials, which would otherwise impede the function and impair the structure of the organs concerned. The abundant flow of pale and watery urine continues until the tubes are cleared of their accumulated contents, and the ejected *débris* of epithelium are visible in the urine so long as this flushing process continues. Another explanation which may be suggested is, that the abundant secretion of urine is a consequence of the urea and the other urinary constituents, which having accumulated in the blood during the desquamative stage of the disease, and subsequently finding a free outlet, exert their natural diuretic influence. That urea is a powerful diuretic has been shown by experiment. Dr. Todd relates (in a clinical lecture published in the *Medical Gazette*, for 1845), that 'he once injected half a drachm of urea into the vein of a dog, and the only effect produced was an excessive secretion of urine. The place where the dog was kept was literally flooded in an hour or two by the frequency and quantity of his micturition.' It is not unlikely that both the influences alluded to, may concur to produce the phenomenon in question. If the one last mentioned were the sole cause, it is not probable that the density of the urine would fall so low as it commonly does at this period of the disease. Finally, the blood being completely purified, and the kidneys having regained their normal condition, the urine becomes natural in quantity and quality, the patient recovers his usual health and strength, and the cure is complete.

Causes.—On this subject, a very few words will suffice, as it has been fully treated of in a previous chapter (chap. ii.) Nearly all the causes there mentioned, may give rise to the form of disease now under consideration. Amongst the most frequent, are the poison of scarlatina, intemperance in alcoholic drinks, the exhausting influence of previous disease, a deficiency of food, fatigue and anxiety, exposure to cold and wet, the cholera poison, and less frequently the poison of measles and of erysipelas. Whatever may have been the exciting cause, the history of the disease, including the morbid anatomy, is essentially the same in all cases, with the exception of those connected with cholera, which differ from the others in running so very rapid a course, that in a few hours they terminate either in recovery or death; although the renal disease probably contributes very little to the fatal result. As illustrations of this form of disease, see the cases No. 7, 8, 9, and 10. It will be seen that the morbid anatomy differs in no respect from that of cases having a different origin.

Diagnosis.—With reference to the subject of diagnosis, very little need be added to what has already been said. Important information may be obtained by a careful examination of the urine with the unaided eye. The dark-coloured, smoky, highly-albuminous urine, with a copious, heavy, dark-brown sediment, is more frequently connected with the acute form of disease now under consideration, than with any other condition.

A microscopic examination of the urine is, however, essential for the formation of a correct diagnosis.* The question to be decided is, whether the case is one of simple acute desquamative disease, or whether it is complicated with a tendency to fatty degeneration, or to some of the forms of chronic disease to be described hereafter—a question which can be confidently and satisfactorily answered only after a microscopic examination of the sediment, and particularly of the appearances presented by the casts in the urine. It would be tedious and useless to repeat here the description given of the appearances which are characteristic of each form of disease, the reader is requested to refer to them and to compare them with each other, and

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* A reference to the cases of hæmaturia, in the eleventh chapter, will show that the urine may have appearances very like those described above, from containing blood alone, while in case No. 26, the same general appearance of the urine was associated with the signs of fatty degeneration of the kidney, which could have been recognised only by a microscopic examination.

with the results of his own examination of actual specimens of urine in different cases—a comparison which he will make with greater care and diligence in proportion as he is convinced of the important fact, that as in all kinds of disease, so especially in diseases of the kidney, the prognosis and treatment must be based upon minute accuracy in diagnosis. It may be well to state that, according to my own observations, the epithelial casts &c. in acute nephritis are essentially the same, whether the disease was produced by the poison of scarlatina, or by any other of the causes before mentioned.

Prognosis.—Although acute desquamative nephritis is always a serious disease, yet it naturally tends to a favourable result, and we may commonly give a more hopeful and favôurable prognosis in such a case, than in any other form of renal disease.

The danger at the commencement of the attack results from the poisoning of the blood by the urea and other urinary constituents, and the risk thence arising of serious disturbance of the nervous centres, or inflammation of the serous membranes or other internal parts. The signs of such secondary mischief should be carefully looked for, but their occurrence, although adding greatly to the risk, must by no means be considered as of fatal import. Cases 3 and 4 may be referred to as good instances of complete recovery after severe attacks of convulsion (renal epilepsy), the one in an adult and the other in a child.

The immediate danger, from poisoning of the blood, having ceased, we now look for the signs of improvement in the condition of the urine. These have already been sufficiently described. We should dread the appearance of any tendency to fatty degeneration, or to chronic inflammation. The signs of such a tendency have been already alluded to, and are more fully described in connexion with the history of these forms of disease.* In forming a prognosis, regard must be had to the previous state of health and the constitution of the patient. The existence of a scrofulous or other unwholesome taint would lessen the probability of a speedy and complete recovery; and the danger is very great when acute renal disease attacks a patient who has been reduced and exhausted by some previous disease. (See the cases of Eliza Smith, p. 75, and James Cowdry, No. 25.) It will readily be seen that, *cæteris paribus*, the risk of some permanent injury to the kidney, or of an irremediable degeneration of the blood, is in proportion to the duration of the disease; therefore the prognosis will be more favourable in cases which have come early under treatment.

* The following cases may be referred to as illustrations of chronic degeneration of the kidney, supervening upon an attack of acute disease, the degeneration being of a different nature in each case. Jane Gatenby (No. 19) had dropsy after scarlatina, followed by continued ill health, and at the end of two years she died, with the kidneys much enlarged and in a state of waxy degeneration. Ann White (No. 27) had two attacks of scarlatina, each followed by dropsy, and after three years she died, with the kidney in a state of fatty degeneration. John Revels (No. 15) had acute dropsy, from exposure to cold and wet; this was followed by chronic desquamative disease, and finally by a partial waxy deposit in the tubes.

It often happens that recoveries, though protracted, are eventually quite complete. In the cases of St. Ledger (No. 1), and Furze (No. 3), the urine was not free from albumen until nearly four months from the commencement of the attack. I have, in several instances, observed, as in the case of Furze, that the urine has continued to be coagulable for many days after all trace of sediment and other evidences of desquamation have disappeared; and I suppose that this has depended partly on the deteriorated condition of the blood, as indicated by the pallor of the skin, and partly, perhaps, on relaxation of the coats of the Malpighian capillaries; a condition which has probably resulted from the extreme engorgement to which the vessels have been subjected during the early and active period of the disease, from which they slowly recover, and which, so long as it continues, permits the serum of the blood to transude. The patient cannot, of course, be considered cured until the urine is entirely free from albumen, as well as from all trace of casts and of desquamated epithelium. The last-mentioned desirable result may, I believe, be confidently looked for, in by far the greater number of cases of acute desquamative disease which have, from the commencement, been subjected to proper treatment.

Two questions of great interest will then arise—first, Has any permanent injury been inflicted upon the kidney? and, secondly, Is it probable that the patient will have a return of the disease?

In reply to the first question, it may be said, that if the urine has returned to its natural condition, being normal in colour, quantity, and density, free from albumen, and from all trace of casts or of renal epithelium, whether entire or disintegrated, the patient is completely cured. It is likely that here and there a tube or a Malpighian body has been spoiled, the first by the destruction of its epithelial lining, and the second by the rupture of its over-distended vessels; but no mischief will result from these changes, beyond the wasting of the parts immediately affected, and the kidneys probably remain as sound and efficient as they were before the attack. The cells which were shed during the desquamative process have been replaced by others, which were formed beneath them, and by which, in fact, they appear to be cast off, so that when the disease has ceased, the tubes are still lined by epithelium, as the skin remains covered by perfect epidermis after the cuticular desquamation consequent on scarlatina. This satisfactory answer to the first question may be given with more confidence, when the disease has come early under treatment, and has yielded quickly to the remedies. When the attack has been much prolonged, so as to have become a chronic disease, there will obviously be a greater probability of the kidney having undergone some permanent structural change. The case of Catherine Russell (No. 2) is an interesting illustration of this point. The desquamative disease had continued in that case for at least six months, but she was rapidly improving, and almost all signs of renal disease had disappeared before her death; which was caused by hæmorrhage on the surface of the brain. The kidneys presented none of the appearances of recent active disease, but some of the tubes had been altered in structure and were dilated into cysts, which would probably have continued to grow and encroach upon the surrounding tissues, if the patient's life had not been cut short by the apoplectic seizure.

Suppose now, the patient to have completely recovered, there then occurs the second question before mentioned—Is it probable that he will have a return of the disease? A little reflection will show that the probability of the disease returning, must in great measure depend upon the nature of the cause which produced the first attack, and the chance of the patient being exposed to the same influence at any future time. When, therefore, the cause of the disease has been obvious and appreciable, we shall be able to give a more confident opinion upon the point in question, than we can do in these comparatively rare cases of acute renal disease, which originate in some obscure and unrecognised cause; because when the source of a disease is unknown, we have no data for calculating the probabilities of its recurrence, nor can the patient be instructed to avoid its hidden causes.

When the attack is clearly traceable to the poison of scarlatina or measles, the probability of a return is very small, because the same patient is rarely affected more than once by either of these poisons. The case of Ann White (No. 27) is an exception to this rule, since she appears to have had two attacks of scarlatina, both of which were followed by dropsy; the last terminating in fatty degeneration of the kidney. In the rare case of a patient having a second attack of scarlatina, if the first had been followed by dropsy, it would be important to take every precaution to guard against a recurrence of this complication. When an attack of renal disease has resulted from the erysipelatous poison, there would be a greater probability of its returning from a repetition of the cause, than in a case of renal disease after scarlatina; because a person who has once had an attack of erysipelas is, from that time, more liable to take the disease than one who has never been the subject of it.

And again, since rheumatic fever is much more likely than typhus fever to be recurrent, so it seems probable that when an attack of renal disease has been consequent on the former of these two maladies, it is more likely to return at some future time from a repetition of the cause, than in the case of its being associated with the latter disease.

When the renal disease has originated in any non-specific cause—such as fatigue, anxiety, intemperance or irregularity in eating and drinking, or exposure to wet and cold—there is, I believe, greater risk of a second attack than in those instances of the disease which are traceable to the influence of a specific morbid poison, such as that of scarlatina. This opinion is based partly upon the actual observation of cases, and partly upon the consideration that the non-specific influences are much more likely than those which we consider specific, to be perpetual or frequently repeated. The danger, therefore, of the disease recurring, will partly depend upon the degree in which the patient is able to avoid the known causes of the disease, and partly upon his self-control, and his care to guard against them. The man who cannot escape the fatigue and anxiety which have occasioned one attack, is obviously in greater danger of a second, than another who has been only for a time, exposed to these depressing influences. A continuance of intemperate habits after the serious warning of an acute renal attack, will almost certainly lead to a return of the malady. Again, when the disease has resulted from exposure to wet or cold, the after-risk will in a great degree depend on the nature of the patient's occupation, and on his ability to avoid the like exposure in future. For instance, the driver of a locomotive engine, or of an omnibus, exposed as he is at all seasons to the inclemency of the weather, incurs a much greater risk of a second attack of renal disease than the mechanic, whose occupation is chiefly within doors, or the sportsman, who occasionally exposes himself for his own pleasure, unless, indeed, the recklessness of the one should make his danger equal to that occasioned by the stern necessity of the other.

When an attack of the disease has been produced by a *slight* exposure to wet or cold, or by any apparently *trifling* cause, there will be a greater probability of a recurrence than when the exciting cause has been such, in its nature and degree, as few persons in perfect health could be expected to resist; because an attack thus easily excited would appear to indicate what, in the absence of a better explanation, we call a predisposition to disease. It is not improbable that a patient, who has had an attack of renal disease excited by *any one* of the before-mentioned causes, may be more than usually susceptible of *all* the influences which are known to produce the disease. For instance, that when scarlatina has been complicated with acute renal disease, any subsequent exposure to cold is more likely to injure the kidney than when there has been no previous attack of disease. I repeat, that such a result is not improbable, but I believe that the risk is very slight when the original disease has been entirely removed; a condition which has been assumed throughout.* It is of great importance that a patient who has once suffered from so serious a disease as acute inflammation of the kidney, should avoid, as much as possible, all the known causes of the disease; and it will be more for his advantage to adopt this reasonable caution, than to trust to any dogmatic, and therefore probably imperfect and one-sided, decision of the obscure question, as to the exact degree in which one attack of disease in the kidney renders the organ liable to be influenced by other causes of disease. It is clearly the duty of the physician, so far as he is able, on the one hand, to relieve his patient from all needless anxiety as to the result of his disease, and on the other, to guard him against that false confidence which would lead him to neglect the care and caution, which the circumstances of his case require.

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* The signs of complete recovery have been given at p. 119 and 120.

TREATMENT.

We come now to the important subject of the treatment of the acute disease, whose pathology we have been considering. It must be evident, that if we have rightly interpreted the phenomena of the disease, if we have duly estimated its causes, and correctly explained the connexion between these and the series of pathological changes consequent upon them, as well as the means which nature adopts for effecting a cure, we are in possession of that light, which alone can enable us to see our way clearly to a correct and rational mode of treatment. There are few truths of more importance, than that the knowledge of a disease is half the cure; few delusions more absurd or fatal, than the notion that a man may be a stranger to pathology, entirely ignorant of the natural history of disease, and yet, withal, be skilful and successful in the administration of remedies. One who is ignorant of the natural course of a disease, is in continual danger of arresting the curative processes which he does not comprehend, and of attributing to the influence of his treatment, the favourable results which nature has effected in spite of his own mischievous interference. On the contrary, precise pathological knowledge, while it guards the practitioner against the sources of error to which the mere empiric is constantly exposed, affords him the surest guide to the natural, and therefore the only successful, mode of treatment.

But the assistance which scientific pathology renders, in guarding against the occurrence of disease, is more valuable than the help which it affords in the treatment, in the same proportion as prevention is better than cure, vaccination preferable to an attack of small pox, and the efficient drainage and cleansing of our dwellings, a more satisfactory work than the medical treatment of cholera or of typhus fever. I believe that a strict attention to the facts and principles embodied in the chapter which has been devoted to the causes of renal disease, and a regard to the practical rules clearly deducible from them, will, in many instances, obviate the necessity for the remedial measures which we have now to consider.

In attempting the cure of acute inflammation of the kidney, we have to remember that there has been, first, a morbid condition of the blood which has excited disease in the kidney, and that, as a secondary consequence of the renal disease, the blood has become contaminated by the retention in it of urea and other excrementitious matters. The object of treatment will be to take care that the kidney be, as much as possible, relieved from its labour of elimination, and that other excretory organs be induced to assist in purifying the blood; and the means of effecting this object will not differ materially whichever amongst the causes before alluded to may have excited the disease in the kidney.

As exposure to cold, whether acting alone or in conjunction with other influences, is amongst the most frequent *causes* of inflammation of the kidney, so there is nothing of more importance in the treatment of the disease than to avoid such exposure. It is remarkable how much benefit the patient generally derives from rest in bed, and in a room of moderate, uniform temperature; the improvement being shown in the diminution of the dropsy, and an increased secretion of less highly albuminous and bloody urine. In a cold season, confinement to bed is absolutely necessary for the patient's well-being and safety, and even in warm weather I believe that it favours and hastens the recovery. Rest in the horizontal posture tends to quiet and equalize the circulation, and uniformity of temperature favours the action of the skin, and prevents the risk of a check to the perspiration.

The next object for general management is the diet. At the commencement of the attack there is generally little desire for food, and considerable thirst; two natural indications by which we may safely be guided. The food should be scanty, consisting of gruel, arrow-root, milk, or weak broth. The patient cannot digest solid food; and if it is taken it will pass in a crude state into the blood, and add to the work of elimination, from which the kidneys are already suffering. Any simple drink may be taken in almost unlimited quantities, with the precaution that the stomach be not overloaded by too large a quantity taken at one time. It seems probable that the thirst is a consequence of the accumulation of urea and other matters in the blood, as thirst is caused by eating common salt or salt meat in large quantities, and that a supply of liquid is required as a vehicle for removing these solid matters from the blood. Perhaps the best drink is pure water; but it may be flavoured with barley, or toast, or lemon, if the patient prefers it. Alcoholic drinks add to the excrementitious matters contained in the blood, produce feverishness and excitement, and stimulate the kidneys; they are therefore to be avoided, unless they are urgently called for by symptoms of exhaustion.

Attention to the above-mentioned points of general management is required in the treatment of every case, and many probably would do well without any additional remedies; the patient only being placed in circumstances which favour the curative efforts of nature. Generally, however, we have to adopt more active measures in proportion to the urgency of the symptoms. In every case it is desirable to ensure free action of the skin and bowels. The first object may best be effected by the hot-air bath and antimonial medicines. The bath may be given daily, and most conveniently while the patient is still lying on his bed; after the bath, free perspiration should be encouraged by a thick covering of blankets. I believe that the hot air is more efficient in promoting perspiration, and more agreeable to the patient in these cases, than the warm water bath. Patients suffering from dropsy, sometimes complain of great distress and difficulty of breathing while in a warm water bath. This was the case with St. Ledger (No. 1), to such a degree that, on more than one occasion, he said he thought he must have died, and I discontinued the bath in consequence. When the hot-air bath cannot be had, the warm water bath must be substituted; and in the case of young children, the latter will, perhaps, be found more convenient. Care must be taken not to keep a child in the bath after it appears faint or suffering much from difficulty of breathing.

There is no medicine more valuable in promoting the action of the skin than antimony. The antimonial wine may be given to an adult in doses of from fifteen to thirty drops, and repeated every four or five hours. Sometimes antimony may be combined with Dover's powder; this is admissible when the bowels are freely open, the urine not very scanty, and when there is no headache or drowsiness. In other cases, opium, in any form, would probably be injurious, on account of its tendency to check secretion and aggravate the symptoms of cerebral oppression. With the precautions before mentioned, and particularly when there is much restlessness, a combination of Dover's powder with tartar-emetic may be useful; five grains of the former with one-sixth or one-fourth grain of the latter may be given twice or three times a day; or the same quantity of antimony, with eight or ten grains of Dover's powder, at bed-time.

In every case we must take care that the bowels are kept freely open, this being one of the most important means of relieving the kidneys from over-work, and one which nature sometimes adopts by setting up a spontaneous diarrhœa. The degree in which the action of the bowels is to be excited must, of course, depend upon the nature and urgency of the symptoms.

In ordinary cases, a moderate action is sufficient; but when any symptoms of cerebral disorder or of other serious mischief arise, the patient must be very freely purged, with the reasonable hope and expectation that by this means the poisonous cause of the mischief will be removed.

A mixture which may be given with advantage, is the common white mixture of sulphate and carbonate of magnesia with peppermint water, and to this may be added the antimonial wine. Another very useful purgative is the compound jalap powder, which may be given to an adult in doses of a scruple or half a drachm, repeated daily, or on alternate days, so as to produce copious watery stools; or the compound extract of colocynth may be given, and it may occasionally be combined with calomel in doses of two or three grains. Great care, however, is necessary in the administration of mercury in all cases of renal disease, since patients suffering from these diseases are sometimes very speedily salivated by small doses, and such a result can scarcely have any but an injurious effect upon the malady. Mercury, therefore, when administered at all in these cases, should be given merely as an aperient, with a view of promoting the action of the liver and increasing the intestinal secretions, for which purpose it may be usefully combined with the colocynth, as before mentioned.

In the majority of cases of acute renal inflammation, the remedies already mentioned will be sufficient to conduct the patient safely through the disease. Not unfrequently, however, something further is required, and the circumstances which indicate the necessity of additional remedies, are a very scanty secretion of highly albuminous and bloody urine, with, occasionally, severe pain in the back, more or less of pain in the head, some degree of drowsiness or delirium, at length, perhaps, convulsions or coma, or an alternation of these two formidable symptoms. These are signs which indicate that the brain is suffering from the poisoned condition of the blood, and this is consequent upon the impeded functions and the extreme vascular engorgement of the kidneys. Under these alarming circumstances I know of no remedy which is so speedily efficient as cupping on the loins. The quantity of blood taken, must depend on the age and strength of the patient. It will seldom be necessary to take more than eight or ten ounces from an adult, and two or three ounces from a child three years of age. It is better to repeat the cupping than to take a large quantity of blood at once. A single operation is often followed by a relief of the pain in the back, a speedy increase in the quantity of urine, and a subsidence of all dangerous cerebral symptoms. The cases of Furze (No. 3) and Stopforth (No. 4) may be referred to in confirmation of these remarks; both patients, the one an old woman, the other a child, were rescued from the most imminent danger, and each by a single operation of cupping, one glass being placed over each kidney. I believe that a much larger quantity of blood might be taken from the arm without affording equal relief; and leeches or cupping on the temples or the neck would be much less efficient in relieving the brain. The object is to relieve the kidneys, and that being done, the secondary consequences of the renal mischief quickly cease. I would not assert positively that venesection is never called for in these cases, but I have never seen a case which appeared to require it. Nor, again, would I be understood to discourage the use of local remedies for the cerebral symptoms. If the scalp is hot, the hair may be removed and iced water applied; and in urgent cases of coma or convulsions a moderate quantity of blood may be taken, by leeches or cupping from the temples; but these means are to be considered only as auxiliaries, and they are not to be used to the exclusion of those which are calculated to relieve the kidneys, and so to remove the source of the cerebral symptoms. It is sometimes urged, by way of objection to bleeding in any mode or degree, that the disease itself produces a rapid deterioration of the blood, and that, consequently, the patient must be injured by the loss of even a small quantity. To which it may be replied, that the deterioration of the blood is a consequence of its being poisoned with urine, and this the result of the renal disease; and if by a small local bleeding we can speedily and effectually relieve the kidney, we shall more certainly prevent a waste of blood than, by a timid practice, permitting the blood to remain poisoned for a longer time; since nothing but actual hæmorrhage has the effect of diminishing the colouring matter of the blood so rapidly as an imperfect excretion of urine. The objection here alluded to, is of force against the practice of general bleeding by venesection, but not against the local bleeding, which is probably much more efficient than the former.

The inflammation of the lung or of the serous membranes, which sometimes occurs as a secondary consequence of the renal disease, must be treated cautiously. There is much reason to believe that mercury is especially injurious in these cases. General bleeding should rarely be practised, but the abstraction of a small quantity of blood by leeches or cupping, will be useful; and when this does not appear necessary, counter-irritation is of service. *This, however, must not be effected by any of those agents which have a tendency, after being absorbed, to irritate and inflame the kidney. Cantharides and turpentine are to be especially avoided.* Mustard, or liquor ammoniæ with oil or cerate, or diluted with water and applied by a flannel or lint covered with oil-silk, is a safe and efficient counter-irritant.

Frequent vomiting is sometimes a distressing symptom at the commencement of an acute attack, when the urine is very scanty. It will be better to encourage the sickness by drinking moderate quantities of warm water, and no direct attempt should be made to arrest it by drinking cold liquids, for the reason that the gastro-intestinal secretions are the means of eliminating some of the poisonous materials which the kidneys fail to excrete,* and it would be dangerous to check this process before another channel is open for the escape of the retained excrement.

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* See p. 193.

It is important to suspend all active treatment in acute nephritis as soon as the improvement in the symptoms permits us to do so; always remembering that the disease has a natural tendency to terminate in health. When the urine begins to be more abundant and of a better quality, and together with this, the secondary symptoms diminish, gentle measures only are required. The patient should still remain in bed, having occasionally a hot air, or a vapour or warm water bath, keeping the bowels regular, and taking diaphoretic doses of antimony. He must still be very careful as to his diet; with children this is especially necessary. I have seen the urine of a child become more scanty and bloody after a meal of potatoes, during the convalescence from the nephritis of scarlatina. When the tongue becomes clean, some good beef-tea or mutton-broth may be given, and as the appetite and powers of digestion increase, solid food may be taken in small quantities, beginning with fish and fowl, and going on to mutton and beef. The voracious appetite which sometimes follows the attack has been already mentioned. It must be cautiously indulged, since it cannot be entirely satisfied even by filling the stomach, and an undigested meal might do serious damage to the kidneys.

When the case is going on quite favourably, the dropsy having subsided, and the urine approaching to a natural condition, the patient may be allowed to dress and sit up, taking care to have flannel next his skin. The period at which he may leave the house will vary according to the time of year and the nature of the season. In cold weather he cannot expose himself to the air without great danger, so long as the urine remains, in any degree, albuminous; but in the warm weather of summer, recovery is sometimes hastened by allowing a patient to take an airing before the urine has become free from albumen. I know nothing more important in the management of these cases, than the exercise of extreme care to avoid exposure to cold during the convalescence. From a neglect of this precaution on the part of the patient or of his attendants, it very often happens that the urine again becomes scanty and more albuminous and bloody; the blood suffers a still greater deterioration, and the disease becomes chronic, and perhaps incurable. I believe that the greater number of cases of chronic renal disease supervening upon an acute attack, are those in which the patient has been exposed from the commencement of the illness, or too early during the convalescence. A patient should not be permitted to leave a hospital after an attack of acute nephritis, so long as any trace of albumen remains in the urine, without being warned of the possibly fatal consequences of his unadvised step. It is obvious, too, that such cases should never be treated as out-patients when it is possible to find a bed, and to persuade the patient to occupy it. There are no cases which more urgently need that kind of treatment which, amongst the poor, they cannot well receive out of a hospital.

It is very generally agreed amongst those who have written on the subject, that iron is of great service during the convalescence. The acknowledged efficacy of this medicine in increasing the colouring matter of the blood, would suggest its use in cases where the blood is so remarkably impoverished, as it evidently is in those who are recovering from acute nephritis; and experience fully verifies these anticipations. The use of the medicine may be commenced as soon as the fever has subsided, the desquamative process having ceased, and the urine becoming copious. At first the citrate of iron may be combined with the citrate of ammonia, and, subsequently, the tinct. ferri sesquichloridi may be given in doses of from ten to twenty drops in infusion of calumba. This medicine is very useful in checking the drain of albumen from the Malpighian capillaries, which, as already mentioned, sometimes continues for a considerable time after all the inflammatory symptoms have ceased. The steel probably acts by improving the condition of the blood, and at the same time, perhaps, giving tone to the relaxed Malpighian vessels, and so it checks the process of secretion or transudation.* If the urine becomes scanty or more deeply coloured and albuminous soon after the use of the steel, it may be necessary to suspend its use for a time, or to give it in smaller doses, and in such a case it may be useful to combine with the muriate of iron the tincture of digitalis in doses of from five to ten minims.

Another remedy which has been recommended for checking the drain of albumen is gallic acid. It may be given in doses of ten grains in solution with muci-

* See ante, page 119.

lage, and repeated three or four times a day. It is more likely to be useful after the acute symptoms have subsided than during the earlier stages of the disease, at which time its administration is not to be recommended.

When the patient has recovered from his attack, he must be instructed to avoid all the influences which are likely to produce a recurrence of the disease, and to fortify himself against them by moderately warm clothing, regular exercise in a pure atmosphere, and temperance in all things.

I have as yet made no allusion to the use of the so-called diuretics, and I mention the subject now only for the purpose of deprecating their employment. A slight consideration of the morbid anatomy and pathology of the disease, will suffice to show that, in the early stage, diuretic medicines must be injurious, 14
while in the later stages they are quite unnecessary. A diuretic medicine is generally some substance which, having entered the blood, is separated by the kidneys, together with a certain quantity of water which is required to keep it in solution, so that, while the process of separation is going on, the quantity of urine is increased. Suppose, however, that the same material is given to a patient whose kidney tubes are choked with desquamated epithelium, and the blood, consequently, poisoned with urea; the effect of such a proceeding is only to increase the mischief, by adding to those materials in the blood which the kidney is striving to eliminate. The scanty secretion is a consequence of the kidneys being over-stimulated and

their structures deranged; and the removal of these impediments, during the natural course of the disease, is quickly followed by an abundant flow of urine—a result which the practitioner, who has been perseveringly administering diuretics, might ignorantly attribute to the influence of his medicines. With our present knowledge of renal pathology, it is clear that the practice of giving diuretics in acute nephritis, is most unjustifiable. I do not include digitalis in this condemnation, its action being entirely different from that of other diuretic medicines, and I have already advised its occasional use.

Appendix to Chapter III.

1. *Illustrative cases.*—2. *Mode of testing for albumen in the urine.*—3. *Mode of making a microscopic examination of the urine.*—4. *The first observation of tube-casts in the urine.*—5. *Is there a disease to which the term desquamative nephritis is applicable?*

Case I.

General dropsy from scanty, irregular diet and exposure to cold. Urine scanty, highly albuminous, and containing 'epithelial casts,' with blood. Subsequently oil in many of the casts and cells. Complete recovery.

John St. Ledger, æt. 49, a billiard-marker, applied to me at the Dispensary on the 12th April, 1847, and gave the following account of himself. For many years he was very intemperate, but latterly he had abstained almost entirely from stimulants. About eight years ago he had an attack of general dropsy, during which his urine was scanty. He was not confined to his bed, and he recovered in about six weeks. Four years afterwards he had a similar attack, from which he recovered in about a month. During this attack he was very drowsy, had pains in his limbs and vomiting; the urine was very dark-coloured and scanty, and he was confined to his bed for a week or ten days. These both appear to have been attacks of acute renal dropsy.

He attributes his present illness to a rigid fast which he observed during the period of Lent. During four days in the week he took only one meal a day, composed of fish, with milk and potatoes; during the remaining three days he took meat as usual, perhaps rather in excess. Under this plan of diet he found himself getting thin and weak, and he became very dyspeptic and flatulent after his meals. About a fortnight before his illness actually commenced, he left off a thick upper coat which he had previously worn, and on several occasions, in coming home at two o'clock in the morning from his miserable occupation, he felt the cold very piercing, and suffered a decided chill. On Easter Monday, April 5, he felt drowsy, and had muscular pains. The next day, general dropsical swelling appeared, and the urine was very scanty. He continued to get worse until the 12th April, when he first came under my notice. He was a well-made, tall, and muscular man, had slight general dropsy with pallor of the face, headache, drowsiness, and thirst. The urine was scanty and dark-coloured, almost solid, with albumen when boiled, sp gr. 1020. It contained numerous 'epithelial casts' (*i. e.* fibrin entangling entire epithelial cells, see fig. 8, p. 89), scattered epithelium and blood corpuscles. The sounds of the heart were normal. He was treated by cupping on the loins, followed by warm baths, purging, and diaphoretics. Under this plan, with low diet, he soon began to improve, the dropsy diminishing, and the urine becoming more abundant and less albuminous. A careful microscopic examination of the urine was made almost daily. Its character continued the same as above reported until the 29th April, when, for the first time, it was observed that many of the epithelial cells contained oil-globules.

At that time I knew much less of the history of this disease than I now do, and in my ignorance I despaired of the patient's recovery.* Day after day the oil was visible, some cells being quite filled with it; but at the same time, by *far the greater number of cells contained no oil*, and this is the fact which, with my present knowledge of the cases, would have suggested to me a very hopeful and favourable prognosis.

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* *See Med. Chir. Trans.* vol. xxx. p. 185.

Early in the month of May the dropsy had entirely disappeared, but he continued very weak and pallid. A few days before this, the symptoms had been aggravated by his going out and exposing himself to the cold winds which prevailed at the time.

On the 6th May he began to take a draught three times daily, consisting of dilute nitric and hydrochloric acid, ten minims of each, in infusion of quassia.

During the month of May, he gained strength slowly, and remained very pallid; the urine continued highly albuminous and sometimes contained blood; the average quantity was three pints in twenty-four hours, sp. g. 1015. Epithelial casts with oil as before.

On the 31st May the acid mixture was discontinued, and he began to take an ounce of mist. ferri comp. three times daily.

Soon after the change of medicine he began to improve in every respect, very rapidly.

On the 14th June the quantity of urine was three pints in twenty-four hours, sp. g. 1017. Colour natural, albumen much diminished. It contained a few casts with epithelium, more or less disintegrated, and scarcely a trace of oil.

At the beginning of July the urine was free from albumen, and presented no trace of oil, but a very few casts with disintegrated epithelium; he was gaining strength, and was much improved in appearance. Once after this, in the month of August, there was a temporary return of albumen, but it soon disappeared, and he completely recovered his health and strength.

He has occasionally since been under my care for trifling ailments. I several times afterwards examined the urine, and found it in every respect quite healthy. Once, in June, 1849, during a severe attack of influenza, the urine was albuminous, but on a second examination, a few days after, no albumen was found.

Remarks.—The exciting cause of the renal disease in this case was probably exposure to the cold night air, after leaving off a portion of his winter clothing. Perhaps his comparatively scanty diet during Lent may have weakened him, and so diminished his power of resisting the influence of cold, or any other noxious agent. The case is a good example of the extent to which oil may accumulate in some of the cells during the progress of desquamative disease in the adult, and yet end in complete recovery. The prognosis in such an instance must be based on the fact, that far the greater number of cells contain no oil; whereas an equal number of oil-containing cells in albuminous urine, without numerous cells free from oil, would have indicated an incurable disease. The benefit derived from the steel mixture was very decided, and to it the patient himself attributes his recovery.

This case affords an example of recurrent renal dropsy. St. Ledger had three attacks, from each of which he completely recovered. The probability of a return is greater in those instances where, as in this case, the disease is excited by the intemperate and irregular habits of the patient, than when it depends on a specific cause, such as the poison of scarlet fever, since, in the former case, the exciting cause may be repeated an indefinite number of times; whereas in the latter, a repetition of the morbific cause forms a rare exception to the rule (see p. 121). I have ascertained that St. Ledger has, since his illness, relapsed into his former habits of intemperance; it is evident, therefore, that he is in continual danger of a recurrence of the disease.

Case II.

General dropsy with scanty and bloody urine, more or less, for about seven months—epithelial casts and blood-corpuscles—Disease of mitral valve.—A complete arrest of renal disease.—Death from cerebral hæmorrhage.—Numerous cysts in the kidneys, the greater number of the surrounding tubes being quite healthy.

Catherine Russell, æt. 59, single, was admitted into King's College Hospital, under the care of Dr. Todd, on the 5th May, 1847, suffering from general dropsy.

She denies that she has been intemperate, but confesses that she likes a drop of gin or porter, and that a very little upsets her. Never had gout or rheumatism, nor any dropsy until the present attack, which commenced, about three weeks before Christmas, with swelling of the legs, which increased rapidly and extended to the belly, face, and hands. She was not exposed to cold, but her diet appears to have been scanty. From the commencement of her illness the urine was passed frequently and in small quantities, and it was deeply tinged with blood. The dropsy continued to increase until the 13th January, when she became violently delirious, and in this state was taken to one of the London Union houses, where she was placed under restraint and had her head shaved. In about a fortnight she recovered her senses. She remained in the union nine weeks, and at the expiration of that period the dropsy had entirely disappeared. In the interval between her discharge from the union and her admission into the hospital she lived in lodgings, upon a very scanty diet; the dropsy returned immediately after she left the union, but in spite of this and of her increasing weakness she continued to walk about, and even went to church.

I saw her immediately after her admission, on the 5th May. She was very drowsy, and fell asleep immediately after she was placed in bed. There was ascites and general anasarca in a great degree, the skin of the legs being tense and erysipelatous, with an ulcer about the size of a shilling on the left. A systolic bellows sound was heard at the apex of the heart. She had passed no urine since the morning, but she now (at seven P.M.) passed about six ounces, which had the colour and appearance of nearly pure blood. It became almost solid when boiled, and contained 'epithelial casts,' with scattered epithelium and blood-corpuscles in great abundance. No oil nor any crystals.

She was placed on milk diet with a slice of mutton, to have four ounces of wine daily, and to take a mixture of sulphate and carbonate of magnesia.

May 7th.—She was already much improved. On the night of her admission there was some muttering delirium, which had now ceased; the dropsy was less, the urine more abundant, less deeply tinged with blood, and much less coagulable, its sp. gr. 1017, and its microscopic characters as on the 5th. She took last night ten grains of Dover's powder—this is to be repeated each night.

On the 8th May she began to take a saline mixture every four hours, and on the 13th this was omitted, and she was ordered a mixture with quinine and sulphuric acid, three times a day.

On the 17th she was gradually improving, the dropsy was much less, the ulcer on the leg nearly healed, appetite good, some headache and thirst, tongue rather dry, urine about four pints in twenty-four hours, sp. g. 1010, of pale colour, very slightly albuminous, and depositing a few 'epithelial casts.' The bellows sound was still audible.

May 26th.—There was more swelling of the legs and more albumen in the urine, partly, perhaps, in consequence of her having sat up the last few days. ℞ Ammon. sesquic., gr. v.; tinct. cinchonæ, c. ♏xv.; decoct. cinchonæ, ℥iss, ter die.

June 4th.—Since the last report she has been daily improving, and she has once been out for an airing. There is still considerable swelling of the legs.

June 14th.—Still improving; she sits up all day and looks well. The urine is about natural in quantity, of pale colour, sp. gr. 1015, just opalescent with heat, and presenting scarcely a trace of casts or of epithelium, but depositing a whitish cloud composed of mucous corpuscles scattered and clustered, the products, as it appeared, of a profuse leucorrhœal discharge which existed at the time.

She continued to improve until the 27th June, when it was reported that she had passed a restless night, having been occasionally delirious. In the morning her countenance was anxious, the urine was still of pale colour, and its sp. gr. 1010; its quantity was diminished. About the middle of the day she was seized with convulsions, which lasted about ten minutes, and left her comatose, with a very feeble pulse. Some wine was ordered. In the evening the coma continued and the urine was passed under her.

On the 28th her condition was the same. An enema had returned without fæculent matter, and a blister applied to the nape had not risen; both were repeated. On the 30th she was better, pulse stronger; endeavours to get out of bed, and appears to wish to speak, but is unable to do so. She takes nourishment.

On the 1st July she was able to speak a little, and took nourishment freely. The only note of the urine is, that it was abundant, acid, sp. gr. 1015. After this she became worse, and died early in the morning of July 3rd.

On inspection a large recent clot was found covering the arachnoid surface of the left hemisphere.

The kidneys were about the natural size, smooth on the surface, and containing in the cortical portion numerous cysts, most of which varied in size from a pin's head to a small pea. One cyst was as large as a walnut, and was filled with a dirty, yellowish, opaque liquid, containing cholesterine and oil, much of the latter being in small cells, forming what are commonly called exudation-corpuscles. The smaller cysts contained clear serum. With the exception of the cysts the structure of the kidney appeared to the naked eye quite healthy. On a microscopic examination there were seen a very few denuded tubes of the natural size (fig. 14), and a few others in process of dilatation. A few tubes contained epithelial particles in process of disintegration, but the great majority of the tubes were quite healthy, having a single layer of normal epithelium within them. There was no appearance of recent desquamation.

Condition of other viscera not noted.

Remarks.—Another example of the influence of privation in producing renal disease and dropsy. But the chief interest of the case is derived from the light which it appears to throw upon the subject of cystic degeneration of the kidney. The desquamative process had continued more or less actively for at least six months; during that time, probably, many tubes had become denuded, and were thus placed in a condition favourable for secreting serum, and the formation of cysts. (See chap. iv.) Some tubes appeared in this denuded condition, but of the normal size, after death, while others had already grown into cysts of various dimensions. The renal disease having been arrested, as was evident from the symptoms during life, and the appearances after death, these cysts might have grown to an unlimited extent; and it is in the highest degree probable, that if the patient's life had not been cut short by the apoplectic seizure, the cysts would have continued to increase and encroach upon the surrounding healthy tissue, until the kidneys had assumed an appearance of a mass of cysts, varying in size from a pin's head to a walnut, or even larger; an appearance which is well shown in Rayer's twenty-sixth plate, and of which most museums have one or more specimens.

Case III.

An insufficiency of food, followed by increasing weakness, and slight general dropsy, intense head-ache, convulsions, and insensibility ; urine scanty and albuminous, with epithelial casts. — Complete recovery.

Ann Furze, æt. 54, residing at 26, Princes-street, Drury-lane. I was called to see her, as a dispensary patient, on the 6th December, 1849. I found her in a state of semi-stupor, and learned that she had been seized with a convulsive fit in the night.

She had a wild, distracted look, and a brown, dry tongue. I found that during the preceding six or seven months she had lived very badly, in consequence of her husband being out of work. She had gradually grown weaker and had restless nights, with frightful dreams and spectral illusions. About a fortnight before I saw her she had become much worse, with vomiting, intense headache, slight general dropsical swelling, pain in the back, and very scanty secretion of urine.

She was ordered to have six leeches applied to the temples, and to take three grains of calomel every four hours.

In the course of the evening some urine was obtained. It had an abundant precipitate of lithic acid, and *contained numerous 'epithelial casts'* (see fig. 8, p. 89), *with scattered epithelium.* When boiled it became almost solid with albumen.

December 7th.—In the morning of this day she was much the same. There had been no return of the convulsions; she had the same wild, half-conscious expression of countenance, and there was frequent vomiting.

Acting now on the knowledge obtained from an examination of the urine, I ordered eight ounces of blood to be taken, by cupping, from the loins; two pills of colocynth and calomel to be taken immediately, and an effervescing draught every four hours.

December 8th.—She was better, and expressed herself as much relieved by the cupping; complete consciousness having returned soon after the operation. She had some sleep in the night, but was disturbed by frightful spectral dreams. Bowels freely opened; urine more abundant with less sediment; still some vomiting; tongue less dry, and cleaner.

To take a mixture of sulphate and carbonate of magnesia with peppermint water three times a day. From this time she steadily and progressively improved. The urine became more abundant, and all cerebral symptoms disappeared.

January 3rd, 1850.—She began to take sulphate of iron with quinine, a grain of each three times a day. At this time the urine had a sp. g. 1010. It was pale, copious, and contained a very few small casts, entangling granular disintegrated particles of epithelium: albumen was still abundant.

February 4th.—The urine had much the same character as a month before. She was still pallid and feeble. The steel and quinine were continued.

March 7th.—The quinine was omitted and the dose of sulphate of iron was increased from one grain to two, to be taken with infusion of quassia three times a day.

During the month of March she became much stronger and in every respect better. She gained flesh; and her face lost its pallor and assumed a healthy hue. Towards the end of the month the urine was free from all trace of albumen, and contained neither casts nor renal epithelium. She remained under observation some weeks after this. The improvement continued, and her recovery was complete. I saw her last in the month of April, 1851. She had been quite well since her last illness, and was then in very good health, with a clear and fresh complexion. I examined the urine and found it entirely free from albumen and from sediment.

Remarks.—This case is one of the many instances which I have met with, in which low diet and its associated mental worry, have given rise to acute renal disease. The microscopic examination of the urine afforded very valuable information as to the nature of the case, particularly as showing that the renal disease was recent, acute, and therefore, probably, curable. Contrast the casts in this case with those in the cases of Hobday (No. 17), and Addis, (No. 16). The benefit from the cupping over the kidneys was very great, and almost immediate. It is important to observe that, as in this case, the urine may continue highly albuminous for some weeks after all active disease has ceased. (See p. 119.)

Case IV.

Dropsy after scarlatina; urine scanty, turbid, with 'epithelial casts' and blood, highly albuminous; severe headache, followed by convulsions; great and speedy relief by cupping over the kidneys.—Complete recovery.

Elizabeth Stopforth, æt. 6, living at 19, Little Wild-street, where I attended her as a dispensary patient. She was seized with scarlatina about the 30th October, 1849. The symptoms were mild until the 16th November, when dropsy appeared in the face and the urine was observed to be high coloured and scanty. The child had always been rather delicate. She had not been exposed to cold since the attack of fever, but had been subject to the opposite, though not less injurious influence of hot air in a small room on the ground-floor, which served as living and sleeping room for a family of five persons, and as a carpenter's workshop for her father.

On the 17th November the urine was very scanty, turbid, and of a dirty greenish colour, almost solid with albumen when boiled; it contained numerous epithelial casts with scattered epithelium and blood-corpuscles, also small crystals of lithic acid. In addition to the epithelial casts there were a few large 'waxy casts.' (See fig. 12, p. 185.)

Ordered a mixture of sulphate and carbonate of magnesia, with ten minims of antimonial wine, three times a day. An occasional warm bath. She continued the mixture until the 22nd November, when, finding that the bowels were much relaxed, I substituted a solution of chlorate of potash in four-grain doses every four hours.

On the 23rd I did not see her, but I afterwards learned that she began to complain of severe headache, which made her scream during the whole day; the urine was very scanty and high coloured, and the bowels confined. About half-past six o'clock on the morning of the 24th, after a restless night, she was seized with a fit of general convulsions, which continued almost incessantly for about two hours. She foamed at the mouth and bit her tongue. When I saw her at half-past nine A.M., she was in a state of semi-stupor, and appeared much exhausted. The bowels had acted involuntarily during the fit.

Ordered a cupping-glass over each kidney and four ounces of blood to be taken. Hydrarg. chloridi, gr. iii. every four hours.

On the 25th she was much better. She appeared relieved very soon after the cupping, and became more lively and cheerful; there has been no return of convulsions; the countenance is natural; has had three or four very dark-coloured motions. The urine is more abundant, of a lighter colour, and has much less sediment and albumen.

November 26th.—She continues to improve; urine more copious; bowels freely open.

Omit calomel, and take ten grains of jalap twice a day.

November 30th.—Rapidly improving. Appetite returned. Since the 24th she had taken only milk and gruel, until yesterday, when she had some broth. Sleeps well. Face pale, and very slightly puffed. Urine more copious than in health, rather pale, slightly cloudy, with a very few casts and scattered blood-corpuscles. The slightest opalescence with heat and nitric acid.

December 7th.—Continues to gain strength, appetite good, tongue clean, urine clear, no trace of albumen. After standing thirty-six hours a rather abundant deposit of lithic acid. The last few days she has been taking tinct. ferri sesquich. three times a day.

December 27th.—Continues well. Urine quite free from albumen.

Remarks.—This case presents the usual features of renal dropsy after scarlatina. The relief from the cupping over the kidneys was as speedy and as decided as in the case of Ann Furze. (See p. 147.) I believe that no remedy is equally efficacious when there are head symptoms, or when, even without these, the urine is very scanty, and when, consequently, there is danger of mischief from the poisoned condition of the blood. The recovery was unusually rapid, and the urine ceased to be albuminous at a much earlier period than is commonly the case. In a similar case now, I should not venture to give more than two or three doses of calomel uncombined with jalap or some other purgative, to ensure its action on the bowels.

Case V.

Sudden epileptic (?) seizure, with rigors and pains in limbs, followed by a purpuric eruption and general dropsy; urine albuminous, with epithelial casts and blood.—Complete recovery.

Charles Fox, æt. 37, a bootmaker. He came to me as a dispensary patient on the 19th July, 1847, when he gave the following account of himself. He was always healthy before the present illness. His habits are strictly temperate; he is not overworked, and his diet has been good. He went to bed well on the night of the 9th July, but when he was dressing on the following morning he had a sudden seizure, which appears to have been of an epileptic nature. He was dizzy and faint, had great pain in the head and confusion of intellect, so that when he set about his work he appeared not to know what he was doing, but there was no convulsion. His wife took his work from him, and he then slept heavily for three or four hours. He could do no more work that day, and he continued drowsy for two or three days afterwards.

He had frequent rigors, a severe pain in the loins, and was thirsty. On the following day, the 11th, he felt a tingling in his legs, and on the 12th he observed small red spots on the legs below the knee; these itched very much, and, enlarging very rapidly, they soon coalesced, forming irregular diffused patches of a bright red colour, and slightly raised above the surface. The inflammation of the skin was most severe on the 14th and 15th; on the 16th it began to subside—he believes in consequence of taking a mixture of magnesia and rhubarb which he got at the dispensary on the 11th.

When I first saw him, on the 19th, the eruption, which was then subsiding, consisted of irregular diffused patches, somewhat raised, and of a rather bright red colour; they were chiefly on the outside of the calf, as low down as the ankle;

they appeared to be getting well in the centre, where they were less elevated and of a fainter colour than at the margins. It appeared to me that *purpura* would be the name most applicable to the appearance. He appeared well nourished, complexion clear, gums sound, tongue clean, no headache, pul feeble, not rapid. As already stated, his habits were regular, his family were all healthy, and there had been no offensive smells in his house. His supper the night before the sudden commencement of his illness, consisted of cold meat with pickled cabbage.

At this time he had no dropsy, but as I had more than once found a similar eruption associated with albuminous urine, I desired him to bring me some urine on the following day.

July 20th.—The urine had a sherry colour, and was clear when first passed. After standing, it deposited a light cloud, containing numerous *epithelial casts* with blood-corpuscles. It was highly albuminous.

On the 21st, about the middle of the day, his wife first observed that his face was puffed, and when he went to bed he found his legs and thighs swollen. On the two following days the swelling continued to increase, and on the 24th, when I again saw him, there was general dropsy; his face was pale and puffed, he had headache, the breath was short, with wheezing and a sense of tightness in the chest.

There is now only a very slight redness in the skin of the legs. According to his own statement, 'As soon as the inflammation of the skin began to die away the swelling of the legs commenced.'

The urine had a sp. gr. 1019. Its appearance and microscopic characters were much the same as when last noted, except that there were many *small waxy casts*, as in the case of Lewis. (No. 22, fig. 23.)

I could not persuade him to come into the hospital, and I ordered him to take a mixture of sulphate and carbonate of magnesia with antimonial wine, three times a day. Pulv. jalapæ comp. ʒss. om. n.

July 28th.—Says he feels better; has less pain in the limbs and head, and the pain in the loins, which, for about a week after the commencement of his illness was very severe, is now much abated. The legs are more swollen and the face is pale and puffed. Tongue clean, rather dry. The eruption has entirely disappeared. Bowels freely open. Urine passed frequently, but in small quantities, sp. gr. 1017, almost solid with albumen when boiled; sediment, epithelial casts and blood as before. The *small waxy casts* less numerous.

August 1st.—Much the same in every respect. I again urged him to come into the hospital, knowing, as I do, that no cases more urgently need rest in bed and an uniform temperature. He was unwilling to leave his home, and concluded that as he could not do what I desired, it would be better for him to discontinue his attendance, so that I entirely lost sight of him until November in the following year, when I met with him in the course of my dispensary practice, and desired him to come to me with a specimen of his urine. He told me that he got well in about two months after his last visit to me. He attributes his cure to drinking broom-tea, of which he took about three pints a day, having been advised by a neighbour to try this remedy. It acted freely upon the bowels. He had continued well since, and appeared then in perfect health. The urine had a sp. gr. 1010, was entirely free from sediment or cloud, and without a trace of albumen.

Remarks.—There are some points of considerable interest in this case. A man goes to bed in good health; on rising in the morning he has a seizure resembling epilepsy, and presents many symptoms which indicate a poisoned state of the blood, rigors, pains in the back and limbs, then an eruption on the skin, and desquamative disease in the kidney, with albuminous urine. It is remarkable that the dropsy came on only after the cutaneous eruption had nearly disappeared. I infer from this, that the cutaneous eruption and the desquamative disease in the kidneys were primary consequences of the assumed poisoned condition of the blood, and that the dropsy was a secondary result of the diminished urinary excretion consequent on the choking of the renal tubes with epithelium, and the associated engorgement of vessels and retarded circulation. Judging from the disappearance of the cutaneous inflammation, the primary poison had been eliminated about the time when the dropsy first appeared; while the subsequent inconvenience was the result of the particular channel through which the poison had passed. If, instead of affecting the kidneys, it had been determined to the intestinal canal, and had excited an excretory diarrhœa, the cure would probably have been much sooner effected. The epileptic seizure at once suggests an analogy with the convulsions which not unfrequently precede the eruption of small-pox, measles, or scarlatina, and which sometimes occur in the early stage of typhus. I once saw a well-marked instance of the last-mentioned complication in a child. In the case of Fox there can be no reasonable doubt that the blood was poisoned; but the nature and cause of the blood-disease are less certain. I suspected that the supper, and perhaps the pickled cabbage—a composition, I believe, of most uncertain nature—had poisoned him. Against this suggestion he urged that he had taken very little of the cabbage; less than his wife and three children, who suffered no inconvenience from it. He, too, had often taken a similar pickle before, without injury. On reference to the case of hæmaturia (No. 32), it will be seen that there was a similar difficulty in deciding as to the nature of the irritant which had excited the hæmorrhage, although the peculiar smell of the urine sufficed to indicate the existence of something abnormal in its composition.

Case VI.

Measles followed by acute desquamative nephritis, with albuminous urine and dropsy; death from inflammation of the lung and pleura. The same appearances in the urine and kidneys as are commonly seen in cases of dropsy after scarlatina. Another child in the same family, affected with dropsy after measles, recovered.

Robert Slough, æt. 5. On the 2nd of June, 1849, my friend Mr. Charles Gage Brown brought me a specimen of urine from this patient, who had been seized with dropsy after measles. The symptoms of measles appeared about a fortnight before, and the dropsy had come on the day before the urine was brought to me.

The urine was smoky, almost solid with nitric acid, and contained epithelial casts and blood—its characters being precisely similar to those observed in the urine of patients who have dropsy after scarlatina.

On the 18th of July, the kidneys of this boy were brought to me, together with some urine taken from the bladder after death. The boy had died with inflammation of the lung and pleura. The urine had the same characters as on the 2nd of June.

The kidneys were enlarged and their surfaces lobed. (See p. 13.) The cortical substance was somewhat pale, with, here and there, patches of congestion. The tubes were, for the most part, opaque, with an excess of epithelium, and many tubes contained blood.

The Malpighian capillaries were opaque, so that the blood-corpuscles within them appeared colourless and magnified. (See p. 101.)

Remarks.—This was an unequivocal case of acute desquamative disease occurring as a consequence of measles, an event which is certainly not very frequent. But it is remarkable that another child in the same family, a boy æt. three, had the same accident. The dropsy came on about ten days after the commencement of the measles, and some urine, brought to me at the same time with the first specimen from the other boy, had the same characters, but contained less albumen than the other. This boy recovered. They were both judiciously treated by warm baths, spare diet, and purgatives. Another child in the same family had measles but no dropsy.

The family in which these cases occurred were miserably poor and dirty; they lived in a close court, and had an unhealthy appearance. Several other children in the court were suffering from measles at the same time; the symptoms of the disease were quite unequivocal, and no scarlatina had occurred in Mr. Brown's practice for some time before. From the extreme rarity of dropsy in connexion with measles, it is reasonable to suppose that it is not more likely to occur as a consequence of this disease, than during the progress of any acute malady, especially when such disease occurs in a subject of unhealthy constitution, or in one enfeebled by insufficient food, or by living in filth and impure air.

Case VII.

Cholera, albuminous urine, epithelial casts and cells. —Recovery.

Richard Floyd was seized with symptoms of cholera on the 2nd of July, 1849. The first specimen of urine that could be obtained was on the 6th of July; if any had been passed in the interval, it was only with the stools. It was acid; sp. gr. 1015; moderately coagulable by heat and nitric acid; slightly smoky; it deposited a rather abundant white cloud containing numerous epithelial cells, and epithelial casts, with some transparent casts having granular particles entangled in them; no blood-corpuscles.

At this time the patient was rapidly recovering. On the following day, July 7th, the urine was entirely free from albumen, and contained neither casts nor epithelium.

He got rapidly well, and the urine was not examined again. Without doubt, an examination during the three or four days after the cessation of the desquamative process, would have detected some *débris* of the epithelium which had been desquamated while the poison was being eliminated by the kidneys.

Case VIII.

Cholera; urine albuminous, and containing transparent casts with a few epithelial cells.—Recovery.

Robert Billeston, æt. 18, had premonitory symptoms of cholera at one o'clock P.M. on the 23rd of July, 1849. He felt a pain in the stomach, and in the course of a few hours he was purged six times. He stated that he made water more frequently and in larger quantities than usual—five or six times in the evening. He also passed water at four and at seven A.M., on the morning of the 24th. At four A.M. he was seized with a spouting vomit, which recurred every quarter of an hour.

He was admitted into the hospital at half-past eight A.M. on the 24th; he then presented the usual symptoms of cholera in the stage of collapse.

At half-past four P.M., one ounce of urine was drawn from the bladder by a catheter. It was rather turbid, very coagulable by heat and nitric acid. It contained a few transparent casts and some scattered cells, which were probably renal epithelium.

On the 25th he was better; the surface was warm, and there was a tinge of bile in the matter vomited and in the stools.

On the 26th he continued to improve. About one pint of urine was drawn from the bladder; it contained a small quantity of albumen, and deposited a brownish sediment, composed of crystals of lithic acid with numerous casts of medium size entangling granular disintegrated epithelium, with but little entire epithelium.

He continued to improve, and recovered; the urine was not examined again.

Case IX.

Cholera; suppression of urine; death after seventeen hours' illness; the uriniferous tubes filled with epithelium, the result of acute desquamative disease.

John Strachan, æt. 40. Went to bed in his usual health on the night of the 19th of July; at four o'clock on the following morning he awoke with griping pains in the bowels, and purging. At half-past eight A.M., when he was admitted into the hospital, he was in a state of collapse, with frequent vomiting and purging. He grew rapidly worse during the day, and died comatose at eleven o'clock the same night, about seventeen hours from the commencement of his illness. He passed no water after his admission, and after death the bladder was found empty.

One kidney sent to me weighed five ounces. Its surface was smooth and somewhat mottled by a mixture of anæmia and congestion. Its texture was firm. On a section the Malpighian bodies were visible to the naked eye, and appeared of a dark red colour. The convoluted tubes were uniformly filled with desquamated epithelium. The Malpighian capillaries were opaque and their outline indistinct; the blood-corpuscles appearing of a lighter colour and larger than natural (p. 101). The intertubular capillaries contained no blood, and were consequently invisible.

Case X.

Cholera, ending in fatal coma, after twenty-eight hours' illness; the uriniferous tubes of the kidney filled with desquamated epithelium.

Mary Phillips, æt. 3½, died in a comatose condition, after being ill with cholera for a period of twenty-eight hours. One kidney weighed an ounce and a quarter. It was in the same condition as the kidney of Strachan (case 9, p. 159). Texture fine, capsular surface smooth, a mottled appearance from a mixture of anæmia and congestion. The convoluted tubes were filled with desquamated epithelium. Here and there one tube contained blood. The Malpighian capillaries were rather opaque, and their surfaces finely granular, a single row of blood-corpuscles in each capillary canal. The apparent size and colour of the corpuscles were less altered than in the case of Strachan, where the capillaries were more opaque and thickened. The inter-tubular capillaries, as in the other case, were empty and inconspicuous.

Remarks.—It will be seen from the reports of the four preceding cases, that the renal disease which results from the cholera poison does not differ from the acute desquamative disease consequent upon scarlatina, or exposure to cold. It is not without interest to remark in how short a time the tubes become filled with desquamated epithelium. In the case of Strachan, for instance, the tubes were distended with recently formed cells, although the duration of the disease had not exceeded eighteen hours.

MODE OF TESTING FOR ALBUMEN IN THE URINE.

The two tests which are most convenient and conclusive, are heat and nitric acid.

The best mode of applying heat, is to put some of the urine in a clean test-tube over a spirit-lamp. The albumen begins to coagulate at a temperature of 160°, and coagulation gradually becomes complete as the liquid reaches the boiling point. When the quantity of albumen is small, the urine may be rendered only slightly turbid or opalescent, then, after standing for a short time, the coagulated albumen collects into flakes which gradually subside to the bottom of the test-tube, leaving the upper part of the liquid clear. When the albumen is very abundant, the urine is rendered gelatinous or almost solid by heat.

The addition of nitric acid to albuminous urine coagulates the albumen. A minute quantity of the acid sometimes forms a coagulum, which is quickly dissolved, but reappears on the addition of more acid; it is important, therefore, to ensure the addition of a sufficient quantity of acid to avoid this source of fallacy. There are, besides, some other sources of fallacy when either heat or nitric acid is used alone as a test for albumen.

1. Heat may produce a white precipitate which is not albuminous when the urine contains an excess of earthy phosphates. The addition of a few drops of nitric acid dissolves this precipitate, and at once distinguishes it from coagulated albumen, which remains undissolved.

2. Heat will not coagulate albumen when the urine which contains it is alkaline.* Therefore, when urine suspected to be albuminous has not an acid reaction, nitric acid must be used as a test.

3. Albumen may escape detection when dirty test tubes are used, since a small quantity of an acid† or an alkali prevents the coagulation of albumen by heat.

4. Nitric acid will sometimes produce a whitish amorphous precipitate of uric acid when the urine con-

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* The effect of alkalies in preventing the coagulation of albumen by heat, was demonstrated by Dr. Burrows in his Gulstonian Lectures for 1834. *Med. Gazette,* vol. xiv.

† Dr. Bence Jones was, I believe, the first to show that a minute quantity of nitric acid in albuminous urine prevents the formation of a coagulum, even at a boiling temperature. *Med. Gazette,* vol. xxvii. p. 288.

tains a large quantity of urates; and this precipitate might be mistaken for albumen. It is distinguished from albumen in not being produced by heat.

5. Nitric acid often produces a white turbid appearance in the urine of patients who are taking copaiba, cubebs, and perhaps some other resinous substances. This is distinguished from an albuminous precipitate by not falling to the bottom of the test-tube after standing, and in not being produced by heat. It is well to remember that large doses of copaiba or cubebs, may actually produce temporary albuminuria, in which case both heat and nitric acid will give precipitates.

MODE OF MAKING A MICROSCOPIC EXAMINATION OF THE URINE.

When the sediment in the urine is abundant, as during the acute stage of desquamative nephritis, it may be subjected to examination immediately, but when the sediment is scanty, it is necessary to allow the urine to remain at rest for some hours before making a microscopic examination. I am in the habit of using for this purpose glasses capable of holding about four ounces, and of a conical shape, like an ale-glass, so that the sediment, when scanty, may be deposited within a small space at the bottom of the glass. It is convenient to have the glasses numbered, so that, if several specimens of urine are to be examined at the same time, a memorandum may be made of the number of each, with the patient's name, when the urine is placed in the glasses. Care must be taken that the glasses are kept clean; for a minute quantity of sediment adhering to the glass, might lead to serious errors in the examination of the next specimen placed in the same glass.

The sediment may be obtained for examination by means of a glass tube open at both ends, the upper end being covered by the finger until the lower is in contact with the sediment; a portion of which may then be made to enter the tube by cautiously removing the finger, so as to allow some of the air to escape. The upper orifice being again closed with the finger, the tube may be removed and its contents transferred to a shallow glass cell, which is then to be covered with a piece of thin glass, and the superfluous liquid removed by absorption with a towel. The sediment, which is now ready for examination, may be subjected to a magnifying power of about 200 diameters—a quarter-inch object-glass with a low eyepiece. No advantage appears to be derived from the use of higher powers than this, and a lower power is insufficient. All the illustrations which I have given of the tube-casts are drawn with a power of 200 diameters, and the other microscopic illustrations are on the same scale, except where it is otherwise stated in the description.

The conical glasses above mentioned, the cells and tubes of a convenient size and shape, may be obtained of Mr. Matthews, surgical-instrument maker, Portugal-street.

THE FIRST OBSERVATION OF TUBE-CASTS IN THE URINE.

It is scarcely possible to ascertain who first observed the appearance in the urine of fibrinous casts of the uriniferous tubes. Drawings of the casts appear in Simon's *Beiträge*, p. 140, and they are described at p. 103 of the same work. The date of this publication is 1843. In the *Zeitschrift für Rationelle Medicin*, for 1844 (p. 57), Pfeufer reports a case of Bright's disease, and states that Henle detected in the urine long cylinders having the diameter of the kidney-tubes (p. 61). This examination was made in February, 1842. The patient died on the 4th March, and Henle observed in the kidney-tubes, cylinders identical with those which he had before seen in the urine. (p. 68.)

The cylinders were described by Scherer in his *Chemische und Mikroskopische Untersuchungen*, 1843 (p. 42). In a note, Scherer refers to Simon's description of them at p. 103 of the *Beiträge*, and states that Henle made to him a verbal communication, to the effect that he had often observed these bodies in the urine. The same bodies are described and figured by Vogel, in his *Icones Histologico Pathologicæ*, p. 108 and plate xxiii. The date of this publication is 1843. It appears, therefore, that the bodies in question were seen about the same time, and independently, by several observers.

IS THERE A DISEASE TO WHICH THE TERM DESQUAMATIVE NEPHRITIS IS APPLICABLE?

Frerichs would answer the above question in the negative. He says, an effusion of albumen and fibrin is the starting-point of the disease which I have described as desquamative nephritis, and he believes that the appearance of renal epithelium in the urine, is simply a result of the cells becoming entangled in the fibrin, which coagulates in the tubes, and escaping thence, drags with it the epithelium. This explanation of the phenomena in question is contrary to facts, and therefore most unsatisfactory. In a well-marked case of acute desquamative disease, the urine contains renal epithelium in much greater abundance than could be accounted for by the hypothesis of Frerichs; and after death, many of the uriniferous tubes, which contain no fibrin, are distended with epithelial cells which have evidently been shed by a vital process of desquamation. There are cases in which an effusion of fibrin or blood into the tubes is unassociated with the desquamative process, and in such instances, although the urine contains numerous casts of the tubes, there is no appearance of renal epithelium; for the obvious reason, that as there is no desquamation, the epithelial cells remain attached to the basement membrane, and the passage of the coagulated fibrin or blood through the tubes, has not the power of bringing away the epithelial lining. Examples of tube-casts without epithelium may be seen in the case of Lewis (No. 22); Harvey (No. 31); and the case of 'a physician' (No. 32).

I have as little doubt of the existence of a true renal desquamation, as I have of a cutaneous desquamation; and I believe that the former can no more be explained by the mechanical action of coagulated fibrin, than the latter by the friction of the patient's clothing.

CHAPTER IV.

CHRONIC DESQUAMATIVE NEPHRITIS.

WE come now to the consideration of a chronic form of renal disease, whose history may advantageously be studied in immediate connexion with that of acute desquamative nephritis, for the reason—1st. That the acute disease occasionally passes by almost imperceptible gradations into the chronic; and 2nd. That while the study of acute nephritis is a useful preparation for understanding the pathology of the chronic disease, there are some points in the history of the latter malady which throw an additional light upon the former; the two diseases therefore will be found mutually to illustrate each other.

The disease in question is characterized by a long continued shedding of epithelium, which appears in the urine in a more or less disintegrated state—a phenomenon which suggested the name of 'chronic desquamative nephritis,'* as sufficiently expressive of the nature of the disease. The tubes gradually lose their epithelial lining, and, subsequently, become atrophied, or filled with some new, and frequently, an unorganized material; or, lastly, they continue to be nourished, secrete serum into their cavities, and so

* *Medico-Chirurgical Transactions*, vol. xxx.

become dilated into cysts. Meanwhile the renal blood-vessels undergo changes which are of great pathological interest and importance. The kidney in the advanced stages is commonly, but not invariably, much wasted, its substance firm, and its surface irregular. The urine is, for the most part, albuminous; its quantity and specific gravity variable; but the former usually greater, and the latter less, than in health. The disease is frequently a consequence of chronic gout, or of some allied disorder of the general health. It produces great changes in the blood, and many and various constitutional disorders consequent upon these changes, amongst which the most frequent and important are anasarca, and dropsy of one or more serous cavities, inflammation of the serous membranes, hypertrophy of the heart, with or without disease of the valves, and lastly either structural changes or great functional disturbance of the nervous centres. Such are the general features of the disease to the details of whose history we have now to direct our attention.

Our study of acute desquamative nephritis has taught us that one of the dangerous consequences of that disease, consists in its tendency to become chronic, unless the patient is early subjected to proper treatment, and unless he is protected from the influence of cold and wet until the condition of the urine and other circumstances indicate that the disease has been entirely removed. One of the *causes*, therefore, of chronic nephritis, is an attack of acute disease, which, either from neglect, or in some cases, perhaps, inevitably, has become chronic. The case of Catherine

Russell (p. 143) has already been referred to as an illustration of the danger of a prolonged attack of acute nephritis. The appearances in the kidney indicated a cessation of acute disease, but there were numerous cysts of various sizes, these being a result, as we shall hereafter see, of changes in the renal tubes produced by chronic desquamation. Again, the case of Revels (No. 15), may be referred to in illustration of the same point. In this case exposure to wet and cold was followed by symptoms of acute nephritis; the attack was not so severe as to prevent him from going on with his work; he was therefore continually exposed, in a greater or less degree, to the same influences which had produced his illness. The disease became confirmed and chronic, and after an interval of about seven months, when he first came under observation, he had the symptoms of chronic desquamative nephritis in an advanced stage. In such instances as these, when the chronic disease originates in an attack of acute nephritis, its commencement is marked by such prominent symptoms that it must attract the attention both of the patient and of his medical attendant, and an examination of the urine reveals the precise nature of the disease. But when the disease is chronic from the commencement, there are few maladies of so serious a nature and so dangerous a tendency, which are equally insidious in their progress, and which, consequently, require so much care and watchfulness on the part of the physician. A reference to case No. 13 will show that a patient may go to bed apparently in good health, and without having experienced any symptoms which had led him to suspect that his kidneys were unsound. In the night he is seized with symptoms of suppression of urine and of severe abdominal inflammation. After an illness of a few hours he dies, and his kidneys are found to be so far disorganized by a disease, evidently of a chronic nature, that the wonder is, not that they ceased to act when they did, but that they had continued to discharge their functions so long.

Again, in case No. 14, there was precisely the same disorganization of the kidneys as in the instance just alluded to. The patient was seized, after a slight indisposition, with palsy of one side, followed by complete insensibility, which soon ended in death. There was no appearance in the brain which would explain the symptoms, but the kidneys were in precisely the same state of chronic disease as those in the case just alluded to. The bladder was empty; no urine had been passed for several hours before death; and the patient's friends had often noticed that his urine was scanty, but he had appeared to be in tolerable health, and his medical attendant was not consulted before the last fatal attack.

There can be little doubt that in both these cases an examination of the urine, chemically and microscopically, would have detected the renal disease long before its fatal termination. It is therefore of much importance to know the causes of this chronic and insidious form of disease, and the circumstances in which it is likely to occur, so that the signs of its presence may be looked for when they do not obtrude themselves upon the notice of the patient or of his medical attendant. It will be unnecessary to repeat in this place, what has already been said, in a former chapter, on the general causes of renal disease, and of their common tendency to produce a morbid condition of the blood. I shall, therefore, only briefly refer to such particulars as have an immediate relation to the form of disease now under consideration. I have already said that the chronic disease may be a vestige of acute desquamative nephritis, but much more commonly the disease is chronic from the commencement, originating, almost imperceptibly, in some derangement of the general health. In a large proportion of cases it is associated with the gouty diathesis. So frequently is this the case, that Dr. Todd is in the habit of applying the term gouty kidney to this form of disease; but the disease is certainly not confined to gouty subjects, or to those who might be supposed to have either an acquired or an inherited tendency to gout. Undoubtedly, however, in the majority of cases, when the subjects of this disease have not actually had gout, they have incurred the risk of it by their intemperate habits. In general terms, therefore, it may be stated that intemperance in drinking is the origin of nearly all the cases of chronic desquamative nephritis; that in a few cases it may be traced to a previous attack of acute disease, and there will still remain a comparatively small number of cases which are connected with a derangement of the general health, the result either of an original weakness or unsoundness of constitution, or produced by the slow and long continued operation of such depressing influences as bodily or mental fatigue and anxiety, deficiency of nutritious food, lengthened confinement to bed by disease or accidental injury, or unwholesome occupations which involve a neglect of exercise and the breathing of impure air. Unhappily, it is too often the case, that those who are exposed to some of the influences just now alluded to, are driven by them into the vice of intemperance, and that thus a number of causes concur to disorganize the kidneys; but, in a few cases the kidneys undergo the same chronic degeneration, when the history of the patient shows that the abuse of alcoholic drinks can have had no share in producing the disease. There can be little doubt that all the causes here alluded to, have a tendency to impair the nutrition of the body, and, in particular, to produce that condition which I have assumed to be the starting-point and the origin of renal disease—viz., a morbid state of the blood.*

GENERAL SYMPTOMS.

I have before stated that chronic nephritis may exist for a long time, and may produce extensive disorganization of the kidneys, without the occurrence of any symptom to attract the patient's notice, or to arouse the anxiety of his friends; and I have referred to two cases in illustration of this important feature of the disease. In most cases, however, a careful examination will show that there

* See chap. ii.

have, for a long time, been some warning symptoms, although the patient, from his ignorance of their nature and import, may have neglected them.

The earlier symptoms are much influenced by the previous state of the patient's health, and the circumstances in which the renal disease occurs. It sometimes happens that the disease in the kidney has advanced, as it were, under cover of some more obvious malady, to which the attention of the patient and of his friends has been too exclusively directed. It is, therefore, a point of much importance to watch for the symptoms of renal disease whenever a patient is worn and exhausted by any other malady, and especially when the disease is one of those which are known to be associated with a morbid state of the blood. This caution is especially called for in cases of chronic gout, this form of renal disease being, as before stated, very frequently associated with gout, and much more so than with any other disease.

Chronic disease of the kidney is commonly preceded and accompanied by some of the following symptoms; a gradual loss of strength, with emaciation to a variable extent, in some cases being very great, while in others it is inconsiderable, or it is concealed by the anasarcous swelling of the body; defective perspiration, with a dry and harsh state of the skin, a peculiar pallid or sallow colour of the skin and lips, or a blending of pallor with a dusky hue, depending on the original dark complexion of the patient. The tongue is sometimes dry, at other times moist and pale; there is commonly thirst with loss of appetite. The last symptom, however, is variable, the appetite being sometimes voracious; there is almost constantly flatulence, and sometimes gastric pain; not unfrequently, too, the patient is troubled with water-brash, or with retching and vomiting, especially on first awaking in the morning; pain or a sense of weight in the head, and sometimes a tendency to drowsiness, are complained of. I have noticed one symptom so frequently in connexion with renal disease, that I consider it worthy of mention, and that is, bleeding from the nose. It occurred in the cases of Hewson (No. 11) and Revels (No. 15). It is probably a result of the morbid state of blood consequent upon imperfect renal excretion. Another symptom, somewhat analogous, and resulting probably from the same cause, is menorrhagia; this occurred to a great extent in the case of Brooks (No. 12). Much more commonly, however, the catamenia are absent, a natural consequence, as it would seem, of the impoverished condition of the blood. Many of these symptoms are inconstant, and they may all be present when there is no renal disease; but they should excite to watchfulness, and to a search for less equivocal signs.

Dropsy is a symptom of much uncertainty in this form of disease. Many cases terminate fatally without the occurrence of dropsy at any period, while in other instances the dropsy is only slight or transient. Frequently there is a slight puffing about the face, and particularly in the eyelids, and this is most conspicuous when the patient has been recumbent, so that it is often visible on first rising in the morning, and disappears under the influence of the erect posture, which at the same time gives rise to a slight swelling of the ankles; and this, in its turn, is replaced by the facial œdema, when the horizontal posture has been for a time resumed. There is occasionally a complaint of pain in the back, but this is seldom more than would be felt by a patient, equally weak, who had no renal disease; often, too, it is not spoken of until the patient's attention has been directed to it, and it is not a symptom which I have found of much value in practice. A symptom which is much more constant, is the fact of the patient being compelled to get up, once or oftener during the night, to pass water, the urine being also passed with increased frequency during the day-time. In some cases this appears to depend on distension of the bladder by an abundant secretion, but in other instances the urine is natural in quantity, or even scanty, and the frequent micturition appears to result from irritation of the bladder, occasioned by the contact of urine in an abnormal state. This symptom of nocturnal micturition is seldom absent, and very often it will be found to have been present for a long time before the occurrence of any other symptom of renal disease; it is therefore very useful, for the purpose of directing the attention of the patient, and of his medical attendant, to the urinary organs; but taken by itself, it conveys no precise information, beyond the fact of the bladder being irritated, and the urine being probably in an abnormal condition. It is not to be supposed that because a patient passes his urine with increased frequency, and is disturbed in the night by a desire to micturate, that he is therefore suffering from disease of the kidney, since the same irritability of bladder will often be found to depend on acidity, or other abnormal conditions of the urine, resulting from dyspepsia, and entirely unconnected with renal disease.

CHARACTERS OF THE URINE.

The signs which are least fallacious, and therefore of most value, which convey the earliest information of the actual existence of renal disease, and which, during all its stages, indicate with the greatest accuracy its nature and progress, are those connected with the state of the urine.

I will now describe the condition of the urine, commencing with the earliest indications of incipient disease, and tracing it onwards to its different results.

The cases in which a search for the earliest signs of the disease are most likely to be successful, are those of chronic gout, and especially when concretions are beginning to form in the joints. In the very earliest stage of renal degeneration no trace of the disease will appear in the urine, except at those periods when there is some inflammation of the joints, or for a short time after the subsidence of the inflammation. It is important to examine the urine when it is not turbid with lithates, otherwise the appearances to be sought for, will be concealed by other products. It will therefore be necessary to wait, in most instances, until the gouty paroxysm is subsiding, when the urine will be found to have the following characters:—In quantity, specific gravity, and colour, it differs very little, if at all, from the standard of health; it is perhaps more acid than usual, but contains not a trace of albumen. When passed it is quite clear, and remains so after standing for a few hours; but it deposits a dense, whitish material, which often looks like fine dust at the bottom of the vessel; the quantity of this sediment is variable, but at this stage it is never abundant. On a microscopic examination it is found to consist partly of a scattered amorphous granular material, and partly of the same material in the form of cylinders, which have evidently come from the renal tubes, and for which I propose the name of 'granular casts' (fig. 11). When

Fig. 11.

Granular epithelial casts.

we examine the kidneys, we shall see that this granular material is evidently disintegrated epithelium, which has become detached from the basement membrane of the tubes, and subsequently washed out with the urine, some of it retaining the cylindrical form, while part is irregularly scattered. Occasionally, too, evidence of the nature of the material is afforded by the fact of the same casts entangling one or more epithelial cells, either entire, or only partially disintegrated.

In the intervals of the gouty paroxysms, when the inflammation of the joints has entirely subsided, there may be, in the very early stage of the disease, no appearances of the granular casts, or only such very slight traces as may require a long and careful search to discover. The appearances here described, are sufficient to show that the epithelial cells are modified during the excretion of the morbid products which accompany the gouty paroxysm. The cells appear to undergo a withering process, by which they become disintegrated, and subsequently washed out with the urine. In this early stage of the disease, when the tissues of the kidney are but little degenerated, and when the poisonous excrement is probably less abundant than in the more inveterate cases, the materials are so promptly eliminated, that the renal circulation escapes that degree of embarrassment which leads to the escape of serum from the Malpighian vessels; the urine consequently is not albuminous, and after the inflammation of the joints has entirely subsided, the excretion of the morbid products appears to have been so complete, that there remains no trace of the desquamative process.

In the next, more advanced, stage of the disease, the urine commonly presents the following characters. During the attack of gouty inflammation in the joints, the secretion is scanty, and its specific gravity rather high; it is also albuminous, and continues so for a variable period after the gouty paroxysm is over, the albumen gradually diminishing in quantity, and at length disappearing entirely, until the next attack of gout brings with it a reappearance of the albumen. A microscopic examination now shows that during the time when the urine is albuminous, there is a more abundant shedding of disintegrated epithelium than in the earlier stage of the disease; the granular casts being numerous, and forming a rather copious, dense, whitish precipitate at the bottom of the vessel. The casts diminish in number simultaneously with the decrease of albumen in the urine, but at this stage of the disease they seldom disappear entirely; traces of them remaining throughout the intervals between the paroxysms, even when there is no admixture of albumen with the urine. The casts are sometimes obscured by a deposit of uric acid, or urate of ammonia, which at this period continues to be excreted in considerable quantities during and after the attacks of gout. In the intervals of the paroxysms, the urine is commonly more abundant than in health, of lower specific gravity, and of a somewhat paler colour. I have already said that the albumen disappears, but that the granular casts remain, though they are much less abundant than during, and for some time after, the gouty paroxysm, when the renal desquamation is more active.

We have here a series of phenomena indicating more advanced and more permanent disease in the kidney, than during that which I have described as the first stage. For, 1st, during the general derangement which accompanies and follows the attacks of gouty inflammation of the joints, the increased number of granular casts shows a more active desquamative process, and the albuminous condition of the urine is evidence of a more impeded circulation; and, 2nd, during the intervals of the gouty paroxysms, the continued presence of the granular casts, though in diminished numbers, shows that the kidneys are constantly excreting some of the morbid matters with which the system is becoming saturated, and of which the so-called 'chalky' deposits, which now often begin to form in the joints and elsewhere, afford one kind of evidence.

We come now to the third and last stage of this desquamative degeneration of the kidneys, in which the condition of the urine varies more than during the two previous stages; each variation, however, being sufficiently intelligible by reference to the condition of the kidneys which accompanies it. It will, of course, be understood that there is no abrupt transition from one stage to another, but that they merge into each other by almost imperceptible degrees.

In the later stages of the disease the urine becomes permanently albuminous; first, there will be only slight traces in the intervals of the gouty attacks, but subsequently the urine is scarcely less coagulable in the intervals, than during the paroxysms of gout.

The quantity of albumen is variable in different cases; it often continues abundant to the very last (see the cases of Hewson, No. 11, Brooks, No. 12, and Addis, No. 16); while in other cases it decreases towards the termination of the disease, and sometimes becomes very scanty. (See the case of Hobday, No. 17.) An explanation of this fact will be suggested hereafter. The quantity of urine, which was greater than natural during the second stage, continues abundant during this later period, and sometimes until within a few days of death, when it often becomes very scanty, and is, sometimes, quite suppressed. It is not unusual for a patient, during the second and third stages, to pass from fifty to a hundred ounces of urine in twenty-four hours. The specific gravity is low, ranging, commonly, from 1006 to 1012. In the advanced stages of the disease the albumen is not generally so abundant as to add much to the density of the urine, but when it is copious, it should be coagulated, and separated by filtration before the density is taken for the purpose of calculating the amount of solids.

The daily discharge of solids is below the average of health, the deficiency varying much in different cases, and at different stages of the disease. The diminution of solids seems to affect all the principles of the urine indiscriminately; but accurate inquiries on this head are still wanted. The precise amount of solids in the urine can be ascertained only by chemical analysis, but the specific gravity and the quantity being known, a reference to the table, given at p. 45, will enable us, by a simple calculation, to estimate the amount of solid matter with sufficient accuracy for ordinary practical purposes. Suppose a patient to pass, in twenty-four hours, sixty ounces of urine, having a density of 1010. According to the table, one ounce of such urine contains 10·283 grains of solids, then 10·283 × 60 = 616·980. In this case, therefore, there would be considerably less than the daily average of solids, which has been estimated at 650. In other cases the deficiency is greater, the density and the quantity of the urine being at the same time much reduced; this is of common occurrence in the last stages of the disease, and is generally a precursor of serious symptoms. In one of Dr. Christison's cases the total solids discharged throughout the day were reduced to one-fifth of the healthy average; and in another nearly to one-twelfth.

It should be remembered that one cause of the diminution of the solid constituents of the urine is the impoverished condition of the blood, which occurs in the advanced stages of renal disease. There exists in these circumstances the same cause for a diminution of the urinary solids, and especially of the urea, as in chlorosis and other anæmic diseases.*

The *colour* of the urine is not an unimportant index of the progress of the disease; in the earlier stages it retains more or less of the natural sherry tint, and it is occasionally deeply coloured with urates; but as the disease advances, the natural colour is gradually

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* Frerichs, *op. cit.*, p. 65.

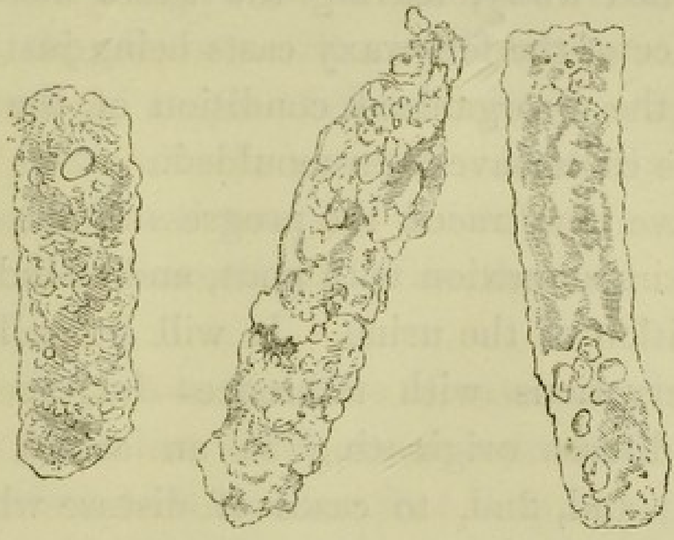
lost, the urine assumes a peculiar whitish, colourless appearance, and, simultaneously, the uric-acid sediments cease, so that the secretion remains clear and colourless, even during a gouty paroxysm. (See the case of Hewson, No. 11.) These appearances are commonly associated with an advanced disease, and with great destruction of the secreting cells of the kidney.

The microscopic characters of the urine in this third stage, vary according to the course which the disease takes, and the mode of termination. There are three varieties of appearances which may be referred to now, but which will be more intelligible when the condition of the kidney has been described.

1st. There is a rather copious, dense, whitish precipitate, composed of granular casts and scattered particles of disintegrated epithelium; and this continues until the urine suddenly becomes scanty, and the patient is seized with convulsions, or with some other secondary consequence of suppressed secretion, and so the case terminates. The case of Hobday (No. 17), is an instance of this mode of termination.

2nd. The sediment is as copious, and presents the same appearance to the naked eye, as in the case last alluded to; but mixed with the granular casts there are some of larger size (fig. 12), and having a peculiar whitish, waxy appearance, with a well-defined sharp outline; their diameter is about $\frac{1}{500}$ of an inch, being nearly equal to that of the kidney tubes; and it will presently be seen that they are moulded in tubes which have been deprived of their epithelial lining by the desquamative process. The number of these casts varies much. When they are numerous, the kidneys will be found to contain within the tubes an

Fig. 12.



Large waxy casts.

abundance of the same material. (See the case of Revels, No. 15.)

3rd. In other instances the urine is colourless and highly albuminous, as in the cases already described, but the sediment is very scanty, sometimes forming only a slight cloud or dust at the bottom of the vessel. It contains the large 'waxy casts' just now described, but in small numbers, and occasionally a few granular casts or some disintegrated epithelium. (See cases of Hewson, No. 11, and Brooks, No. 12.) The appearances of the kidney in these cases, are different from those observed in connexion with the second variety of urine; most of the tubes are found entirely stripped of their epithelial lining, and their walls formed only of basement membrane, here and there one tube being filled with the waxy material.

We have here, then, an explanation of the almost complete disappearance of the granular casts from the urine; the epithelium has become degenerated and washed away, leaving the tubes denuded, the appearance of the few waxy casts being just sufficient to show the disorganized condition of the tubes in which the casts have been moulded.

We have now traced the progress of the disease as it occurs in connexion with gout, and as indicated by the condition of the urine. It will be well to add a few observations with reference—1st, to cases of chronic disease originating in an attack of acute nephritis; and, 2nd, to cases of disease which commence in a chronic form, but which are unconnected with gout. The appearances in the urine which indicate a transition from acute to chronic inflammation of the kidney are, a persistence of the albumen, a gradual decrease of colour and density, with a continued copious secretion, and a more or less abundant and dense sediment, composed of granular casts with scattered amorphous epithelium; this sediment continuing for a longer period, after the cessation of the acute desquamative process and the disappearance of the epithelial casts, than could be explained by the clearing of the tubes from the epithelium and the blood, which have accumulated in them during the acute stage, and which, subsequently, become disintegrated and washed out. (See p. 90.)

Allusion has already been made to the fact that the urine frequently continues to be of a light colour and albuminous for a considerable period, sometimes even for several weeks, after the cessation of acute inflammation. In such cases we infer, from the absence of the granular casts, that there is not a continuance of the desquamative process in a chronic form, and that, probably, the albumen will soon disappear. The urine in the advanced stages of chronic disease supervening upon an acute attack, presents essentially the same appearances as in those cases which have been chronic from the commencement. (See the case of Revels, No. 15.)

With reference to the class of cases which begin in a chronic form, but which are unconnected with gout, it is important to remember that they may commence in the most insidious manner and make great progress without the occurrence of any very obvious or alarming symptom. The appearances in the urine afford the only certain test of the existence and progress of the disease, and these, so far as I am acquainted with them, are essentially the same as those observed in the instances of the same disease occurring in connexion with gout. The practical inference, therefore, is, that the urine must be carefully examined when there is anything in the condition of the patient to excite a suspicion of renal disease.

It may be well to mention here one negative fact; I allude to the absence of blood from the urine in cases of chronic desquamative nephritis. We have already seen that in acute desquamative disease the urine almost constantly contains more or less blood, whereas, when the disease is chronic it rarely happens that any blood-corpuscles appear in the urine; and the more advanced the disease, the less frequently does the urine contain blood. We shall see hereafter, that, in this respect, the urine of chronic nephritis resembles that of some other forms of chronic disease, and we shall find a satisfactory explanation of the fact in the thickened condition of the Malpighian capillaries. There is yet another fact with which it is important to be acquainted. I have already mentioned the increased frequency of micturition which accompanies chronic nephritis, and I suggested that it is a result of irritation of the bladder produced by the contact of morbid urine. Another result of the same irritation, and also an evidence of its existence, is a shedding of epithelium from the mucous membrane of the bladder, together with pus-corpuscles, which form a sediment, having, to the naked eye, much the same appearance as that presented by materials derived from the kidney. On a microscopic examination, the vesical epithelium, consisting of broad flattened scales, is readily distinguished from the renal epithelium and casts, but the latter may be, in some degree, concealed by the former; and if, from a hasty examination, we were to conclude that all the sediment, as seen by the naked eye, was derived from the kidney, we should form a wrong estimate of the rate at which the disease is progressing.

In females a leucorrhœal discharge sometimes constitutes another source of deception of the same kind. This usually contains pus-corpuscles and broad pavement epithelium from the vagina or uterus, the pus being scattered or irregularly clustered, and quite unconnected with the casts, and the epithelium being entirely different from any renal product; they cannot, therefore, mislead a careful observer. The caution with regard to these matters is analogous to that required in a young auscultator, lest he mistake a rhonchus for a friction sound, or permit it to conceal one which actually exists.

CONDITION OF THE BLOOD.

In the chronic forms of disease the blood has some characters in common with the blood of acute nephritis, but in other respects it differs.*

1st. The serum is more abundant in proportion to the clot; the buffy coat less frequently appears, and where it does, the clot is remarkably small and contracted; the fibrin is usually natural in its proportions, and only occasionally abundant when some local inflammation is set up.

2ndly. The density and solid contents of the serum, which in the acute disease are much reduced, are in the chronic variety often equal to the healthy standard, and sometimes even exceed it. There appears to be an inverse proportion between the quantity of albumen in the urine and the density of the serum. The natural density of the serum is from 1029 to 1031, and the proportion of salts and albumen, according to Dr.

* Dr. Christison is my chief authority for these observations on the state of the blood. The cases which he refers to as examples of granular kidney in an advanced stage, and in which he analyzed the blood, are easily identified, by their histories and post-mortem appearances, with the chronic desquamative disease.

Christison, from 816 to 853 in ten thousand parts of blood. In the middle stage of the disease, when the urine is moderately albuminous, the density of the serum is about 1024, and the proportion of albumen and salts from 630 to 660 in ten thousand parts. In the most advanced stage, when the urine was only slightly coagulable, Dr. Christison has seen the density of the serum 1031, and the proportion of its salts and albumen to the entire blood as high as 973 in ten thousand parts. Again, in the same stage, where general reaction and pleurisy had supervened, the density of the serum was 1021, and the solids of the serum amounted only to 583 parts in ten thousand of the blood. It appears, as a general rule, that the albumen continues to be deficient, and the serum low in density throughout the more advanced stages of the disease, and that an approach to the normal standard is exceptional.*

3rdly. The hæmatosin or colouring matter gradually diminishes as the disease progresses, and at length is reduced so much as to form less than a third of the healthy average; so that, as Dr. Christison remarks, there is no chronic disease which so closely approaches hæmorrhage in its power of diminishing the red particles of the blood.

4thly. Urea may commonly be found in the serum, in variable quantities, being most abundant when there is a great reduction in the daily discharge of solids by the kidney, and least so when there is a

* Frerichs, p. 71.

copious secretion of urine, although its density may be considerably below the healthy standard. Towards the close of the disease, when the urine is sometimes almost suppressed, the serum often contains urea in large quantities.

SECONDARY DISEASES.

In describing the symptoms of chronic inflammation of the kidney, I have alluded briefly to some of the secondary diseases induced by it. It will be instructive now to consider them more at length, and to do this in connexion with the morbid anatomy of the organs affected by them.

Dropsy.—Amongst the most frequent and important of these secondary diseases is dropsy. It is, however, a less frequent consequence of this form of renal disease than of any other of the diseases associated with albuminous urine. Many cases pass through all the stages of the disease without the occurrence of dropsy in any form or degree. (Cases Nos. 11, 13, 14, 16.) One, if not the chief, cause of the comparative infrequency and mildness of dropsy in connexion with this form of renal disease, is the free escape of water through the kidneys; for although extensive dropsy is sometimes associated with a copious secretion of urine, it is much more common with a scanty discharge of water. I have already described the dropsy as it occurs in a slight degree, and the effect of position upon it. Anasarca is more common than dropsy of the serous cavities; the latter form of dropsy seldom occurs without the former, and not often to a great extent in any case, without an extreme degree of anasarca or the existence of some local cause. Thus, an abundant effusion into the pleura or pericardium, is commonly associated with inflammation of the serous membranes, and a great degree of ascites is generally consequent upon peritonitis or some obstructive disease of the liver. When the dropsical effusion is excessive, as it sometimes is, it constitutes one of the most serious and distressing complications of renal disease, producing painful distension, and often erysipelatous inflammation of the integuments of the legs, and by its accumulation within the chest and abdomen, embarrassing the circulation and the breathing in a most alarming degree. The removal of the dropsy by the discharge of the accumulated liquid is usually attended with much relief; but the disappearance of extensive dropsy without the escape of water by any natural or artificial outlet has not unfrequently been followed by other secondary diseases, such as coma or chronic vomiting, or an exasperation of these diseases when they have existed previously.

Dyspepsia. — Symptoms of gastric disorder are amongst the most frequent and troublesome of the secondary consequences of renal disease. I have before alluded to them in connexion with acute nephritis, and they are usually present in a greater or less degree throughout the progress of chronic disease. In the mildest form of disorder there may be only a sense of weight and fulness, with flatulence after eating; but the flatulent distension is sometimes so great as to produce serious inconvenience. A man was admitted into King's College Hospital, suffering from extensive dropsy with renal disease, and also regurgitant disease of the aortic valves. On the day of his admission he had a fit of urgent dyspnœa, apparently occasioned by great flatulent distension of the stomach coming on after his dinner; this went off, but the next day a hearty dinner was followed by the same symptoms in a more distressing degree, and he died before relief could be afforded him.

Chronic vomiting is another, not unfrequent, symptom. Occasionally the sickness occurs on first awaking in the morning, while, in other cases, it is more frequent after meals. The matters vomited vary according to the period at which the sickness occurs, and whether before or after eating. Sometimes the symptom assumes the form of water-brash, and a considerable quantity of liquid is ejected, which may be acid or alkaline, or neutral and tasteless. When the renal secretion is very scanty, the matters vomited have often a dark colour and an offensive smell, and MM. Bernard and Barreswil have shown,* that in dogs, after extirpation of the kidneys, the contents of the stomach and intestines contain a large quantity of ammonia, the result, as they suppose, of the excretion of urea, which is subsequently decomposed by the secretions of the alimentary canal. They found that this vicarious excretion of urea continues until the animal becomes weakened, when the stomach and intestines lose the power of eliminating the urea which

* *Archives Générale de Médicine*, 1848.

then, and not until that period, accumulates in the blood.

Diarrhœa is another symptom closely allied to that of vomiting, and probably depending on the same physiological law—viz., that when one excretory organ fails in the discharge of its functions, other organs make an effort to do its work. The elimination of urea, in the form of ammonia, by the gastro-intestinal mucous membrane, has been already mentioned; but, besides, urea itself has been detected in the intestinal discharges. This, then, probably, is one source of the diarrhœa which sometimes occurs in connexion with chronic disease of the kidney.

It is important to distinguish between those cases of diarrhœa which result from this excretory function of the intestines, and other cases which originate in local irritation of the mucous membrane of the bowels by their contents. It is probable that instances of both kinds occur in connexion with renal disease, the stomach, whose functions, as already mentioned, are often much deranged, permitting its contents to pass onwards in an imperfectly digested state, and these acting as irritants upon the mucous surface of the bowels, and so producing a diarrhœa analogous to that which frequently results, in persons otherwise healthy, from an inordinate fæculent accumulation in the intestines.

The morbid anatomy of the stomach and intestines, in cases unconnected with phthisis, consists, for the most part, in mere vascular engorgement of the mucous membrane, with alterations of colour varying from a bright red to a dark brown, and sometimes an appearance of increased mucous secretion on the surface. Dr. Christison states, that in Edinburgh, where diarrhœa appears to be a more frequent and serious complication of renal disease than elsewhere, the mucous membrane of the intestines is sometimes found ulcerated.

Pulmonary Disease.—The lungs seldom escape some degree of derangement. The slightest departure from the normal state is engorgement, with an œdematous effusion into the air-cells, producing more or less of dyspnœa, with wheezing and cough. In other cases, bronchitis occurs in a chronic form, and is attended by a copious secretion, with the physical signs of great engorgement of the lungs, and distressing dyspnœa.

Pneumonia occurs much less frequently than bronchitis, less frequently, too, in connexion with chronic inflammation of the kidney, than as a consequence of acute nephritis. Its progress is sometimes slow and insidious; it is therefore important to watch for any signs of increased dyspnœa, and particularly to make a frequent and careful physical examination of the chest.

Tubercular disease of the lung is so seldom associated with chronic inflammation of the kidney, that there is no reason for supposing the existence of any special relationship between them. It is not improbable that if this chronic renal disease occurred in a person predisposed to phthisis, the morbid tendency might be favoured and the disease developed; nor is it unlikely that chronic inflammation of the kidney may be an occasional consequence of pulmonary consumption; but this kind of connexion between the two diseases, is not of frequent occurrence.

Inflammation of the Serous Membranes.—This constitutes one of the most serious complications of chronic renal disease, seldom occurring except in the advanced stages, or when, from exposure to cold or other causes, the function of the kidneys has been suddenly impeded, and the blood consequently has become charged with poisonous excrement. Pleurisy and pericarditis are the forms which it most frequently assumes; peritonitis occurs less frequently. They may exist singly or in conjunction; and the inflammatory attack may be sudden, urgent, and manifest, or insidious and latent. The two first diseases will generally reveal themselves by their physical signs; but the peritoneum may be extensively diseased, with but few symptoms to make known its condition.

Chronic Rheumatism is one of the less serious associates of renal disease, but it is a very common and a very obstinate complaint. Dr. Christison was, I believe, the first to direct attention to this complication; and it occurs, as he says, so commonly, that he never meets with a case of obstinate chronic rheumatism without being led to make inquiry into the state of the urinary secretion. It is usually unattended with swelling or redness of the affected parts, and appears to be seated in the muscles more frequently than in the joints, though the joints are sometimes swollen and painful. I think, too, that I can confirm Dr. Christison's observation, that it is less common when there is much dropsical effusion than when the anasarca is inconsiderable. Without doubt it is one of the consequences of the morbid state of blood induced by the renal disease.

Coma and Convulsions.—Of all the secondary consequences of chronic renal disease, the most serious are those connected with the cerebro-spinal functions, and assuming the form of coma or convulsions. So frequently do these symptoms occur, that the disease may almost be said to have a natural tendency to terminate in this manner. When convulsions or coma occur as a consequence of acute nephritis, they are often developed rapidly; but in connexion with chronic renal disease their approach is more gradual. There is first, perhaps, an unusual degree of drowsiness, with some dimness of vision or headache, and occasionally slight delirium; the drowsiness continues for some days, increasing gradually, and at length passing into complete stupor, with occasional attacks of epileptic convulsions, each of which is succeeded by more profound coma, which quickly ends in death. In other cases, after a slight degree of drowsiness or headache, the first alarming symptom is a sudden attack of convulsions, followed, perhaps, by delirium, and, after a longer or shorter interval, by a recurrence of convulsions, which may be repeated many times in the course of a few hours, the patient being in the interval either delirious or comatose; the latter condition almost invariably preceding the fatal termination.

In other cases the fatal coma is preceded by a sudden hemiplegic seizure (Case No. 14), the attack having all the characters of apoplexy from cerebral hæmorrhage.

Sometimes it is found that life has actually been cut short by sanguineous effusion into the substance, or upon the surface, of the brain (Case No. 2, p. 143); but in most cases there is the same absence of morbid appearances as in cases of acute nephritis having a similar termination. In some instances there may be a doubtful congestion of the brain or its membranes; much more commonly an unusual paleness, with perhaps some serous effusion on the surface, or in the ventricles; very rarely is there any pus or lymph, or other unequivocal product of inflammation.

These cerebral symptoms are very commonly associated with a scanty secretion of urine, and large quantities of urea may often be detected in the blood, and in the serum about the brain. Although there can scarcely be a doubt that the convulsions and the coma are consequences of the morbid state of blood, resulting from imperfect urinary excretion, yet we know very little of the immediate cause of the mischief. It is in the highest degree probable that urea is a poisonous agent, but we have no proof that it is more so than other urinary constituents which must, with the urea, be retained and accumulate in the blood, when the kidneys are so much disorganized as they are often found to be. Dr. Christison states, that in some cases the daily discharge of solids by the urine may for weeks together be reduced to one-fourth of the natural amount, without any symptom of an affection of the head supervening, and, moreover, when an analysis of the blood shows that it is loaded with urea. Dr. Bright relates a case to the same purpose. A person labouring under disease of the kidney, lived for four or five years under his occasional observation. The blood was analyzed in the earlier stage, and found to contain a large quantity of urea; yet this patient had no fits till towards the close of his life. And Dr. Rees states, that he examined the blood of a patient who had his senses about him to the last moment of his life, and whose blood was more impregnated with urea than that of any case of Bright's disease that ever came under his notice. These facts seem to be in opposition to the theory that urea is the poisonous agent in these cases, and they suggest the possibility, that some other of the urinary constituents, although perhaps less abundant, may be more injurious when retained in the blood. On the other hand, it may be said that perhaps some unknown condition of the blood—Dr. Rees suggests a certain degree of tenuity* — may be necessary for the poisonous operation of urea. Further, the operation of all narcotic poisons is notoriously uncertain, and widely different in varying circumstances. A dose of opium which would have a scarcely appreciable effect upon one patient, will make another wakeful and excited, and in a third will perhaps pro-

* A watery condition of the blood is obviously not essential for the poisonous action of urinary excrement, since the most urgent symptoms of blood-poisoning may occur as a consequence of acute renal disease, when there is no reason for supposing that the aqueous portion of the blood is increased.

duce a degree of drowsiness almost amounting to coma. It is not unlikely that the condition of the patient in whose blood urea accumulates, may differ as much as that of the three recipients of the opiate dose. The same difference is occasionally observed in the operation of other poisons. For instance, one patient will be salivated by a quantity of mercury fifty times less than would be required to produce the same effect upon another. These observations will suffice to show that the apparently uncertain effect of urea, when accumulated in the blood, is no proof that it is not really a very poisonous agent; they also show that it is desirable to ascertain the conditions which favour or retard its poisonous action, and also, whether there may not be other urinary constituents which, being retained in the blood, exert an injurious influence, either by themselves, or in conjunction with urea.*

It is surprising to see how entirely unaffected the cerebral functions sometimes continue when only a few ounces of urine are secreted daily. So far as I have seen, this can occur only in chronic cases, and where the urine has been gradually reduced in amount: a sudden suppression from acute nephritis, or a sudden great diminution of the secretion in the course of

* Suppression of the biliary secretion is attended by consequences as variable and uncertain as those associated with suppression of urine. Drowsiness is a very common consequence. Convulsions and coma are happily of less frequent occurrence. We cannot doubt that the mixture of bile with the blood is the cause of these symptoms, although in other cases, when there are all the appearances of as abundant an accumulation of bile in the blood, there is an entire absence of cerebral symptoms.

chronic nephritis, is generally followed quickly by serious symptoms. And it will probably be found that, in most cases, when there is a very scanty discharge of solids by the kidney, without urgent symptoms, there is some vicarious secretion. In the case of Hewson, for instance (No. 11,), the fœtid liquid which he vomited, probably contained some of the urinous excrement which the kidneys failed to eliminate, and the escape of which, by means of the gastro-intestinal mucous membrane, prevented the poisonous effects which might otherwise have ensued.

Dr. Watson suggests,* that 'the pale and watery condition to which the blood is at last reduced may have something to do with the stupor and coma;' and he compares these symptoms with those of spurious hydrocephalus, which occur in conjunction with a similar defect of hæmatosin. 'It would seem,' he says, 'that, under such circumstances, the functions of the brain are exercised irregularly, languidly, and at length not at all, in consequence of the failing supply of its appropriate stimulus through the arteries.'

There is no necessary connexion between cerebral symptoms and the extent or increase of dropsy. The most sudden and serious attacks of coma or convulsions may occur when there is no dropsy, or there may be a great degree of dropsy without even drowsiness; yet it very often happens that drowsiness and dropsy commence and increase together, until complete coma supervenes.

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* *Lectures on the Principles and Practice of Physic,* vol. ii. p. 626.

It need scarcely be added, that coma coming on in the course of chronic inflammation of the kidney, is always a sign of fearful import, and that an epileptic seizure is scarcely less so. The premonitory symptoms should always be regarded with anxiety, and attempts made to avert the threatened danger. When drowsiness has passed into complete coma, a fatal result is almost inevitable.

Since writing the preceding account of the nervous symptoms, associated with a diminished excretion of urine, I find that Dr. Frerichs* gives an entirely new explanation of the phenomena in question. He is of opinion that the symptoms of blood-poisoning are not immediately due to the accumulation of urea, or to that of any other of the solid constituents of the urine in the blood, but that they are occasioned by the carbonate of ammonia which results from the decomposition of urea within the bloodvessels. He supports his opinion by observation and experiment. He states that the air expired by patients who are labouring under symptoms of uræmic poisoning (coma, convulsions, &c.) contains an appreciable quantity of carbonate of ammonia, as shown by the restoration of the colour of reddened litmus paper, which has been moistened and placed before the mouth and nose, and by the fumes which appear when a rod dipped in muriatic acid is placed in the current of expired air. The quantity of carbonate of ammonia in the expired air bears, he says, a proportion to the intensity of the

* *Die Bright'sche Nierenkrankheit*, pp. 107—112.

symptoms. He also states that the blood in the same circumstances always contains carbonate of ammonia, which is sometimes so abundant as to be detected by the sense of smell, and to produce effervescence on the addition of muriatic acid. In addition to these observations, Frerichs gives the results of some experiments which he performed on dogs.

After injecting urea into the veins of dogs whose kidneys had been previously extirpated, he found that the animals remained for some time (an hour or more) free from symptoms of poisoning. After an interval which varied from one hour and a quarter to eight hours, they became restless, and vomited, then were seized with convulsions, followed by stupor. Ammonia was detected in the expired air simultaneously with the commencement of the convulsions, and after death, which followed the injection of the urea in from two hours and a quarter to ten hours, the blood and the contents of the stomach contained large quantities of ammonia.

In another series of experiments, a solution of carbonate of ammonia was injected into the blood of the animals. Convulsions came on immediately, and often were very violent, but they were soon succeeded by stupor. The expired air was at the same time charged with carbonate of ammonia, and continued so for more than an hour, when the exhalation of ammonia gradually ceased, and consciousness returned. A fresh injection of carbonate of ammonia during the period of stupefaction brought a recurrence of convulsions with vomiting, and an involuntary passage of urine and fæces. After five or six hours the ammonia again disappeared, and the animal's vivacity returned.

These experiments are certainly in favour of Frerichs' notion that the carbonate of ammonia which results from the decomposition of urea is the poisonous agent, and not urea itself; and this being the case, it ceases to be surprising that a large accumulation of urea in the blood may be unassociated with any symptoms of uræmic poisoning. In order to account for the decomposition of urea in some cases and not in others, Frerichs assumes the existence of some peculiar ferment in the former instances which is not present in the latter; but he has no knowledge of the nature of this supposed agent, and there is here a hiatus in his observations, all of which will require repetition before the theory which is based upon them can be admitted amongst the established doctrines of pathology.

Disease of the Heart.—The frequent co-existence of cardiac and renal disease was long since pointed out by Dr. Bright, and his earlier observations have been confirmed by the later experience of himself and others. In the first volume of the *Guy's Hospital Reports*, while passing under review the chief morbid appearances observed in one hundred cases of renal disease connected with albuminous urine, Dr. Bright thus alludes to the subject of cardiac disease:—'The deviations from health in the heart are well worthy of observation; they have been so frequent as to show a most important and intimate connexion with the disease of which we are treating; while at the same time there have been twenty-seven cases in which no disease could be detected, and six others which, from not having been noted, lead to the belief that no important deviation from the normal state existed. The obvious structural changes in the heart have consisted chiefly of hypertrophy, with or without valvular disease, and, what is most striking, out of fifty-two cases of hypertrophy, no valvular disease whatsoever could be detected in thirty-four, but in eleven of these thirty-four, more or less disease existed in the coats of the aorta; still, however, leaving twenty-three without any probable organic cause for the marked hypertrophy generally affecting the left ventricle. This naturally leads us to look for some less local cause for the unusual efforts to which the heart has been impelled: and the two most ready solutions appear to be, either that the altered quality of the blood affords irregular and unwonted stimulus to the organ immediately, or that it so affects the minute and capillary circulation, as to render greater action necessary to force the blood through the distant subdivisions of the vascular system.'

When we come to the consideration of the pathology of dropsy I shall endeavour to prove that the latter of the two explanations suggested by Dr. Bright is, probably, the true one, and that this hypertrophy of the muscular substance of the heart, without disease of the valves, is a consequence of the renal disease with which it is associated.

In a great majority of cases, too, the structural changes in the valves, occurring in connexion with disease of the kidney, are a consequence of the poisoned condition of blood produced by the renal disease. I have already (chap. ii. p. 66) alluded to those cases of renal disease which result from a pre-existing disease of the heart, and I have endeavoured to explain the connexion between them.

It may sometimes happen that disease of the heart and kidney will co-exist in the same subject, without being connected as cause and effect. A patient, for instance, may have had rheumatic endocarditis, producing permanent structural change in the valves, and, subsequently, he may become gouty, and, as a consequence, have chronic inflammation of the kidneys.

In any case, the conjunction of valvular disease of the heart with renal disease is an unfavourable circumstance and a serious complication, since the two maladies almost invariably exert a mutually injurious influence upon each other. We shall see hereafter that the existence of hypertrophy of the muscular substance is rather a favourable circumstance, and is designed to overcome some impediment to the circulation, whether arising from defective valves or a morbid condition of the blood.

Disease of the Liver.—The liver is found to be more or less diseased in a large proportion of cases of chronic nephritis, a fact which is not surprising when it is considered that free living and intemperance, which are the most frequent causes of this form of renal disease, are also very influential in exciting disease of the liver. It is therefore probable, that in a large proportion of cases the two diseases are the result of one common cause. It is also a conclusion fairly deducible from physiological considerations and from analogy, and not entirely unsupported by actual observation, that a disease in one of these organs tends indirectly to excite structural changes in the other. In a former chapter (chap. ii.) I alluded to the influence which one excretory organ, by an imperfect discharge of its functions, has in producing functional disturbance and structural change in any other organ of a similar nature which may be called upon to eliminate from the blood materials foreign to its own proper secretion, but which have been assigned to it in consequence of the failing function of the organ primarily diseased. And in another place (p. 108) I have described the manner in which the kidney-cells are changed while striving to eliminate bile. It appears, therefore, in the highest degree probable, that renal and hepatic diseases do act and react upon each other.

The form of hepatic disease which is most frequently associated with this chronic nephritis is that which is commonly called cirrhosis, or the gin-drinker's, tuberculated or hobnailed liver. And it seems probable that the two diseases are as closely allied, as is consistent with the difference in the structure and functions of the organs concerned. The hepatic disease may often be detected by the enlargement apparent on percussion and manual examination. Sometimes, however, there is contraction and induration; in which case ascites is commonly present, and often in a greater degree than the co-existing anasarca. Dr. Christison well suggests that 'whenever ascites presents itself in a considerable degree without material anasarca, whenever it remains after anasarca is removed, whenever, in short, ascites forms the prominent dropsical affection, there is very great probability that the liver is seriously disorganized.' Occasionally there is pain or tenderness about the liver and a sallow tinge in the skin or conjunctiva.

MORBID ANATOMY AND PATHOLOGY OF THE KIDNEY.

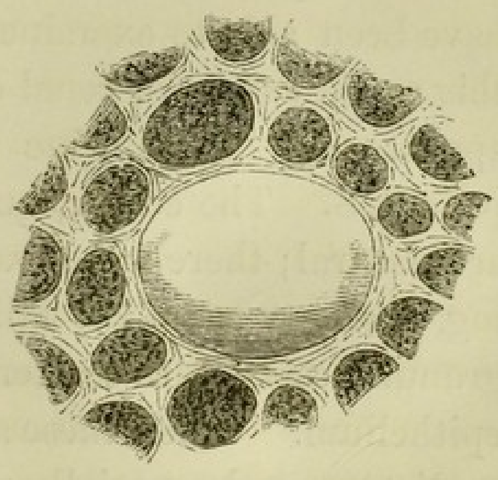
I believe that I shall best succeed in giving a clear and intelligible account of the morbid anatomy and pathology of chronic nephritis, by describing each morbid appearance, and in immediate connexion with it, giving what appears to be its pathological interpretation. It will be convenient to begin with the earliest and slightest deviations from the normal condition, and thence to pass on to those appearances which indicate a more advanced and extensive disease.

I must beg my readers to bear in mind the facts and arguments which have been before adduced to prove that a morbid state of the blood is the original cause of renal disease, and that an altered action and appearance of the epithelial cells is at once a consequence and an evidence of that morbid condition of the blood.

An opportunity of examining the kidneys in a very early stage of chronic disease, sometimes occurs in cases where death has been occasioned by some other malady.

The kidneys are then of the natural size and weight, and they present to the eye no appearance of disease, or there may be some irregular congestion on the capsular surface, but the lobular markings are distinct and natural—one of the surest outward signs that there is not much structural change in the organ. On a microscopic examination, the only deviation from the normal appearance is in the epithelial cells of the convoluted tubes. These are opaque, and have an unusual, finely granular appearance; in some tubes there is an appearance of entire cells having been shed so as to fill the tubes and render them opaque; while in others there is an equal filling and opacity of the tube, from containing epithelium in a disintegrated condition, and which has become so either from the crumbling of the cells while they are still attached to the basement membrane, or from the disintegration of the epithelial cells which have accumulated in the tubes after being shed in an entire form by a process of desquamation. (Fig. 13.) In most cases it is probable that the cells become disintegrated by both the processes here described, but in other instances, which are comparatively rare, many of the tubes are seen to be filled with disintegrated epithelium, but in none of them is there any evidence of the true desquamative process; in

Fig. 13.



Section of kidney in which the tubes are rendered opaque by an accumulation of epithelium within them. A Malpighian body in the centre appears transparent, and free from deposit. The fibrous rings of the matrix in which the tubes are packed, and by which they are partly concealed, give the appearance of the tubes being in detached globular and oval portions.

other words, none of the tubes contain entire epithelial cells which have been shed and detached from the basement membrane.*

The condition of kidneys here described, may often be seen in cases of death from some chronic diseases, and especially in gouty and rheumatic subjects. As there have been no prominent renal symptoms during life, it is seldom that the urine has been carefully examined, and it often happens, either that the bladder is empty, or that attention has not been directed to the subject until it is too late to obtain a specimen of the urine. For the practical purposes of diagnosis it is important to ascertain whether the condition of kidney above described, may not be recognised during life by a microscopic examination of the urine. So far as I have been able to examine the matter, it appears that this earliest stage of renal disease is indicated by those appearances in the urine which I have described at page 178. The colour, quantity, and specific gravity are natural; there is no trace of albumen; after standing, a scanty sediment falls, and this contains a few granular casts, with scattered particles of disintegrated epithelium. When these appearances in the urine are persistent, and especially when the quantity of disintegrated epithelium is found to increase from week to week, it is of the greatest importance that their nature and import should be known, and that some means

* Let it not be supposed that the distinction between these two modes, in which the epithelium becomes disintegrated, is a needless process of hair-splitting; for it will hereafter be shown that it has a peculiar interest in connexion with the process of cyst-formation in the kidney. (See p. 223.)

should be adopted to change the patient's condition and check the progress of a disease which, though now slight and apparently insignificant, will, if unchecked, continue until it has destroyed so much of the epithelial structure of the kidney that the organ becomes unfitted for the discharge of its important functions.

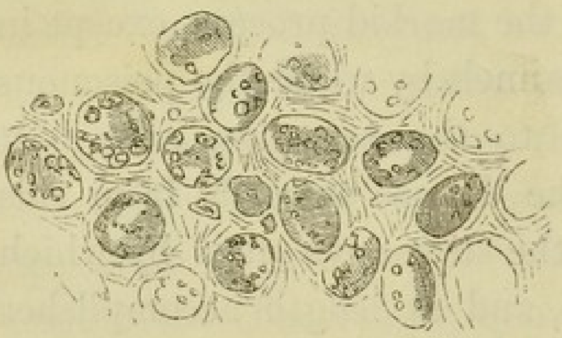
I must here repeat what has so often been asserted before, that the central and starting point of all renal disease is a morbid condition of the blood; the secreting cells of the kidney strive to remove from the blood some of the poisonous materials with which it is charged, and in doing so, they become changed in appearance and structure. At the beginning the blood-vessels have no share in the morbid process, except in so far as they are the channels by which the poisonous materials are conveyed to the secreting cells. It remains now to trace the disease onwards from this starting point, through the successive steps by which it involves other tissues, and at length accomplishes the destruction of the entire gland.

It is important first to understand the effect which the continuance of this chronic desquamative process has upon the cells and upon the tubes which contain them. I have already shown that acute desquamative disease may leave the kidney as sound and efficient as it was before the attack.* But when the process of epithelial desquamation is long continued and becomes chronic, it has a destructive influence upon the cells, and prevents their reproduction. It is not difficult to

* Page 120.

understand at least one of the processes by which this result is accomplished. A microscopic examination shows that some of the tubes become so completely filled by their epithelial contents, that a further formation of cells within them is impossible for want of room, so that the reproduction of epithelium appears to be entirely arrested. After a time, that which has been thrown into the tubes becomes disintegrated and washed out by the liquid which is still being poured into the tubes from the Malpighian bodies. The basement membrane of the tube is thus left quite denuded, or with only a few broken particles of epithelium scattered over its surface (fig. 14). The stages of the process by which a tube filled with desquamated epithelium becomes emptied and denuded by the disintegration and the subsequent washing away of its contents, may readily be traced by examining a few sections of almost any specimen of the disease in an advanced stage. With reference to the two processes, already alluded to, by which the epithelium becomes disintegrated, I have observed that only the true desquamative process leaves the tubes quite denuded, and that the disintegration of the epithelium, unaccompanied by desquamation, destroys

Fig. 14.

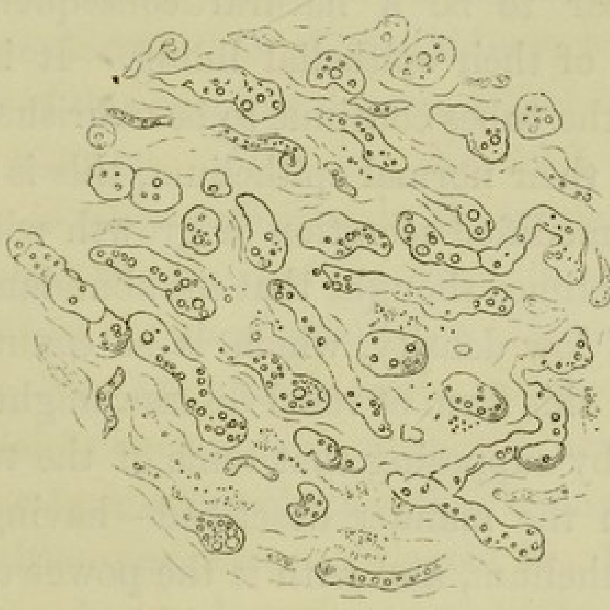


Section of kidney in which the tubes, being deprived of their epithelium, and, in part, concealed by the fibrous rings which surround them, have a delusive vesicular appearance.

the tubes without a previous denuding process. I shall again refer to this in connexion with the subject of cyst-formation in the kidney.

We have now to examine the condition of the tubes subsequent to the denuding process above described. Apparently the most common result of the destruction of the epithelium, is the gradual wasting of the tube. The tubes may always be identified by the peculiar manner in which they are packed in the meshes of the matrix, and also by the appearance of their contents; a few broken and scattered particles of epithelium adhering still to their inner surface, and

Fig. 15.



Section of kidney, showing the tubes in process of atrophy, after the destruction of their epithelial lining. A few granular remains of the epithelium are scattered over the interior of the tubes. The continuity of the tubular with the apparently vesicular portions, is readily demonstrated by a change of focus when the specimen is under examination; it is also shown by the identity of appearance and structure.

rendering it easy to trace them dwindling down from their normal size to an almost invisible degree of minuteness. (Fig. 15.) The addition of acetic acid will sometimes clear the specimen and render the tubes more distinct. In consequence of the wasting of the tubes and the collapse of the surrounding tissues, the Malpighian bodies are brought closer together, so as to appear relatively more numerous, and sometimes three or four of them may be seen almost in contact with each other. (Hewson, No. 11.) I shall have again to refer to this wasting of the tubes, but it will not be out of place to remark here, that as the epithelium is the essential part of the tube, and as its normal action upon the blood is necessary for the maintenance of the circulation, so the decay and atrophy of the tubes appear to be a natural consequence of the destruction of their epithelial lining. It is probable that when the tubes continue to be nourished after the removal of their normal epithelium, this is associated with some modified secretion or growth within them. I have sometimes thought that the abundant secretion of urine of low density, which is so commonly associated with this form of renal disease, might be in part explained by supposing that some of the tubes, when denuded in the manner described—having lost their normal epithelium, and with it the power of secreting the solids of the urine—may yet continue to pour out a watery secretion, which would dilute the urine and diminish its density. Another explanation of this abundant flow of watery urine is one which I have before suggested (p. 114)—viz., that the particles of epithelium which are thrown into the tubes stimulate the Malpighian bodies and excite them to pour out a current of liquid, the purpose being to wash away the *débris* and clear the tubes.

The materials which are occasionally found in the degenerated tubes are, first, an unorganized fibrinous or albuminous material; second, oil; and third, serum.

The albuminous or fibrinous material is the same which forms the 'large waxy casts' which have been already mentioned. (See fig. 12, p. 185.) It appears to be the result of the last remains of secretory power; a power which suffices to separate materials from the blood, but not to organize them into cells. This material accumulates in very different degrees in different cases. Occasionally the desquamative process may pass through all its stages, and accomplish the complete destruction of the kidney, without any appearance of this peculiar deposit either in the urine or in the kidneys. (Hobday, No. 17.) In other cases there is only sufficient in the urine to indicate the nature and the stage of the renal disease, and the kidneys contain but small quantities (Hewson, No. 11, and Brooks, No. 12); while again, in other instances, this material is very abundant in the urine, and the kidneys contain it so largely that they have a yellowish-white, wax-like appearance. (Revels, No. 15.) There can be little doubt that the material in question is secreted by the basement membrane after the destruction of its epithelial cells.* In the case of Revels, its

* That the larger waxy casts are secreted by the basement membrane, and not by the Malpighian bodies, is rendered probable by the fact, that these casts are sometimes hollow; having a distinct, but irregular, canal in the centre. This affords evidence, that the

first formation in the kidney was indicated by the appearance in the urine of the waxy casts, which rapidly increased in number until they became more numerous than the granular casts which had previously existed alone.

A deposit of *oil* in the denuded tubes is not an uncommon occurrence, but it is observed in only a very few of the tubes. The oil sometimes appears to be contained in cells, but more frequently it is in clustered masses, having much the appearance of ordinary adipose tissue. The tubes sometimes appear distended and dilated by their fatty contents, and it is probable that they may grow together to an indefinite extent, and that this is the origin of those cysts which, as large as a hazel-nut or a walnut, are sometimes filled with fatty matter.*

A third condition in which the tubes are often found

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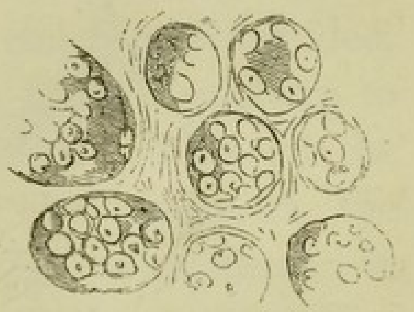
coagulable material is derived from the circumference of the tube, and that it is not poured into the centre of the tube from the Malpighian body, as is probably the case with the small waxy casts, (fig. 22, chap. vi.), and the blood casts (fig. 27, chap. xi.)

* In a paper on the inflammatory diseases of the kidney, in the thirtieth volume of the *Med.-Chir. Transactions,* I stated that these masses of fatty matter were occasionally washed from the tube and appeared in the urine; and I gave a sketch of what I believed to be such a mass, (plate vi. fig. 8.) Since the publication of that paper I have frequently observed bodies similar to the one there figured, and I have discovered that they are clusters of starch, the result of flour or crumbs of bread having accidentally fallen into the urine. Since I have been aware of this fallacy I have not once seen any appearance which indicated that the masses of oil above mentioned escape from the tubes, so as to be detected in the urine; and I take this opportunity of correcting the erroneous statement which I formerly made upon this point.

after losing their normal epithelial lining, is one of dilatation, a process which appears to be associated with the secretion of serum into their cavities, and which continues until they become visible to the naked eye and form the cysts which, in variable numbers and of different sizes, are amongst the most frequent results of chronic inflammation of the kidney.

It appears that the normal epithelium is never reproduced in those tubes which, having once become quite deprived of it, are thus entirely denuded. But occasionally there may be seen some tubes which are lined by a layer of very delicate, transparent, nucleated cells, such as may be supposed to secrete a serous or watery liquid, and these cells appear to have taken the place of the normal epithelium (fig. 16). The tubes which have this peculiar lining are either of the normal size, or, what is perhaps more common, they are larger than ordinary tubes, and appear to be undergoing a process of dilatation. I do not remember to have seen these cells in any tubes below the natural size, and which I suppose to be diminishing from atrophy. It appears, therefore, a reasonable inference that the cellular lining in question is an evidence of life and growth in the tubes which possess it. I am not certain whether these cells are necessary for the secretion of serum into the tubes, or whether the

Fig. 16.

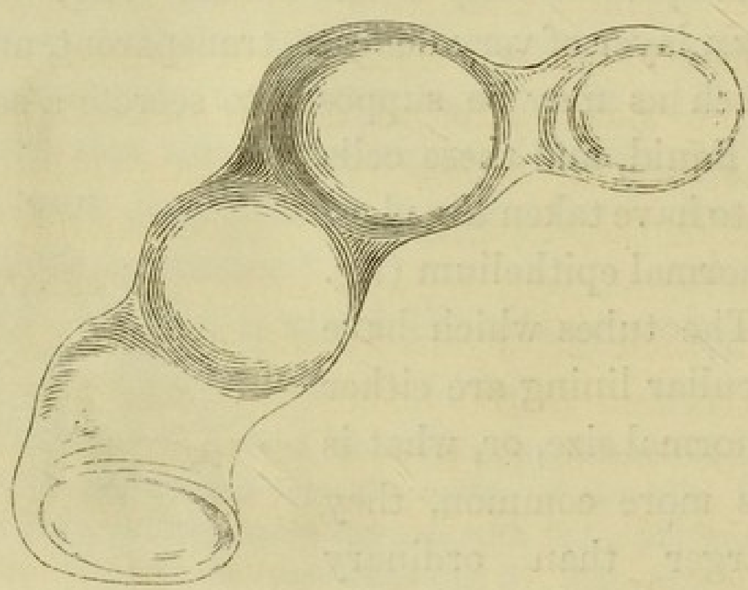


Sections of tubes in which a layer of delicate nucleated cells has taken the place of the normal epithelial lining.

denuded basement membrane alone has this power of secretion, but I think it probable that the cells are always present in the early stages, and that, subsequently, when the serum accumulates and dilates the tubes, their cellular lining becomes flattened and inconspicuous.

There is no difficulty in tracing the tubes through every degree of dilatation, from the normal size up to cysts visible by the naked eye. (Fig. 17.) The pecu-

Fig. 17.



Portion of tube much dilated, and bulging in the intervals of the fibrous rings by which it has, in parts, been constricted. The open mouth of the tube is seen at one cut extremity.—Med. Chir. Trans. vol. xxx.

liar appearance which the fibrous matrix gives to the tubes, is rendered still more striking when the tubes, having lost their epithelial lining, become transparent. In this condition, as they are alternately visible in the meshes and concealed by the fibres of the matrix, they have so much the appearance of globular and oval vesicles, that no one who saw them for the first time could do otherwise than mistake them for such. There is but one mode of avoiding this error, and that consists in comparing the appearances of the healthy kidney with those of the diseased structures. The fibrous matrix should first be examined apart from the tubes, as represented in fig. 3, p. 17; then thin sections of kidneys with the tubes in various conditions—containing blood (fig. 4, p. 17), opaque with desquamated epithelium (fig. 13, p. 209), empty and denuded (fig. 14, p. 212, and fig. 15, p. 213), or lined by newly formed transparent cells (fig. 16, p. 117). The tubes in every condition will present, here and there, the same delusive appearance of being in detached, circular, or oval portions; and if in one condition alone they look like cysts, this is merely because they are transparent only when empty and denuded, while in their arrangement and in their relations to the matrix and to the bloodvessels they have all the marks by which they may be identified with the tubes. A careful examination will always detect, in immediate contact with the cyst-like appearances, unequivocal portions of elongated tube having the same structure and contents as the other parts, and evidently identical and continuous with them, the continuity only being concealed by the fibrous tissue in which they are packed.

A different account of the origin of renal cysts has been given, first by Mr. Simon, and subsequently by Professor Rokitansky and by Mr. Paget. It will be necessary to refer to the description given by these eminent men, but in order not to interrupt the history of chronic nephritis, I shall do this in an appendix to this chapter.

The cysts usually contain an albuminous liquid, which is limpid and colourless, or of a pale yellow tinge ; but it is sometimes of a dark brown colour, in which case it is usually also thick and more or less viscid, and occasionally the contents are almost solid. Some of the solid constituents of the urine have occasionally been detected in the liquid contents of the cysts. It will be apparent that the cysts cannot generally contain any of the urinary constituents, from the fact that the gland-cells are usually destroyed and washed away before the tubes become dilated. Those cysts which are filled with the dark-coloured and more solid materials usually contain fat more or less abundantly, with some ill-defined and amorphous dark pigment. I have occasionally seen numerous crystals of cholesterine, but more frequently uncrystallized vesicular fat, either free and scattered, or clustered in cells. I have already mentioned the fact of the denuded tubes being occasionally distended with oil, and there can be little doubt that in them we see the origin of the fat-containing cysts.

It may be asked, why should liquid accumulate in the tubes so as to dilate them into cysts ? And in reply to this question two answers may be given—first, if the reasons which have been suggested* for believing that ciliated epithelium exists in the convoluted tubes of the human kidney, be considered conclusive and satis-

* Page 40.

factory, then the destruction of the normal epithelium, which necessarily involves that of the cilia, will sufficiently account, by the removal of an efficient propelling force, for the uncertain escape and occasional accumulation of the contents of such tubes as still retain any secretory power.

But besides this explanation there is another, which may perhaps be considered more satisfactory. In examining the tubes near the medullary cones, there may be seen some which are completely filled and obstructed by solid epithelial particles which have apparently become impacted there after being washed from parts of the tubes nearer the Malpighian bodies. It is clearly impossible that their contents should escape from these tubes, and it follows, that whatever materials are secreted within them, must accumulate and distend them. The nature of the accumulated contents will, in a great degree, depend upon the condition of the tube and the period at which the obstruction occurs. If at the time of its occurrence the tube retain any portion of its normal epithelium, it would naturally follow that some of the solid constituents of the urine should form part of its contents, but if the proper gland-cells had already been entirely removed, a serous or albuminous liquid would form the sole contents of the cyst.

There is yet another fact which deserves consideration in connexion with this part of our subject. I shall presently show, that so long as a tube retains its normal epithelial lining, it continues to receive a full supply of blood, and that the circulation through the

Malpighian capillaries ceases only after the tube has lost its proper secreting power. It is probable that the continued stream of water which the Malpighian bodies naturally pour into the tubes, helps to keep them clear and to prevent the obstruction and accumulation which more readily occur after the destruction of the Malpighian bodies and the cessation of this flushing current. The removal of the epithelium from the tubes, and the arrest of the Malpighian circulation, follow so closely upon each other, that it is not possible to estimate separately the influence which the supposed ciliary power of the former, and the watery secretion of the latter, may have in preventing accumulation in the tubes. Nor, again, is it easy to decide as to the possibility of a cyst-formation, without a mechanical obstruction of the tubes by their solid contents, in the manner just now described. It is probable that each condition might singly suffice, still more likely that two or more are commonly combined to produce the result, and certainly there are few pathological phenomena which admit of a more complete and satisfactory explanation, after a careful study of all the circumstances in which they occur.

The cysts, as they appear to the naked eye, exist in very variable numbers; sometimes only one or two will be found in each kidney, while in other cases they are so numerous as to leave little room for the natural tissues, and the kidney is much increased in size and weight. They are generally less numerous when the disease is steadily progressive and ends in great wasting of the kidney, than in other cases when the disease has been arrested, although in the former case the denuded but undilated tubes may be very numerous (Hewson, No. 11), while in the latter there may be scarcely a trace of such tubes on a microscopic examination. (See the case of Catherine Russell, No. 2, p. 143; *remarks.*) It seems probable that a progressive chronic desquamation involves all the tubes in its attendant atrophy, while the arrest of the disease after a certain number of tubes have been denuded is favourable for their development into cysts; their own feeble circulation and impaired nutrition being assisted and maintained by the influence of the surrounding healthier tissues, so that the cysts may continue to grow for an indefinite time after the cessation of the morbid process in which they originated. I have before (p. 209) alluded to the fact of there being two processes by which the epithelium becomes disintegrated in the tubes; 1st, by a breaking up of the cells while they are lodged in the tubes, after being thrown off from the basement membrane in an entire form; and, 2ndly, by the crumbling away of the epithelium while it still remains attached to the basement membrane. It is probable that both processes usually concur in the same kidney, although one or the other may greatly predominate, and, in some instances, there may be no appearance of the first process, which may be called one of true desquamation, the other being one of disintegration alone. I have observed, that while both processes lead to the wasting of the kidney, the first alone appears to remove the epithelium so as to leave the tubes denuded, while the second produces atrophy of the tube without a previous process of denudation, the crumbling away of the epithelium and the wasting of the tube apparently going on simultaneously. (Compare the cases of Hobday, No. 17, and Addis, No. 16.) It will be apparent, therefore, that the cyst-formation is a more frequent consequence of the true desquamative than of the merely disintegrative process, since the tubes generally lose their epithelium before they grow into cysts. In the case of Catherine Russell (No. 2, p. 143), although the appearances in the urine had indicated an active desquamation, there were only very slight traces of denuded tubes, for the reason that the disease had ceased some time before death, and the spoiled tubes were rapidly growing into cysts, which the naked eye detected in great numbers.

It should be borne in mind that the tubes lose their epithelial lining, and are thus prepared for the cyst-formation, only after a long continuance of the desquamative process. I have not seen them denuded in any instance where the probable duration of the disease has been less than in the case of Russell (No. 2, p. 143), which was six months. With a knowledge of these consequences of desquamative disease, we shall see the importance of subjecting all cases to early treatment, and of exercising a watchful care over them until the disease has been entirely removed.

VARIETIES IN THE EXTERNAL APPEARANCE OF THE KIDNEY.

Since the outward appearances of the kidney are chiefly dependent on the condition of the tubes, it may be well to advert to them before passing on to the microscopic examination of the bloodvessels. I have already described* the microscopic appearances which may frequently be observed in cases of incipient disease, when, as yet, there is scarcely any change in the outward appearance of the kidney. As the disease advances, a diminution of weight and bulk is the result which is more constant than any other. The wasting at first affects only the cortical substance, which becomes thinner, so that the bases of the medullary cones gradually approach the capsular surface of the kidney. One of the most constant outward marks of this atrophy is a more or less complete and general obliteration of the lobular divisions on the capsular surface. As the disease progresses the appearances are modified, chiefly by the secondary deposit within the tubes, which has already been described as forming the 'large waxy casts.' The simplest cases are those in which this material is either entirely absent, or present only in such small quantities as to produce no appreciable change in the appearance of the kidney. In these cases the kidney continues to waste, but retains, in a great degree, until an advanced stage, its smoothness

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* Page 209.

of surface (Hewson, No. 11); there is a gradual decrease of vascularity, and finally, in some cases, an extreme degree of atrophy, so that the weight and dimensions are reduced to perhaps one-fourth of the natural standard. The surface is whitish, firm, and corrugated, with, here and there, patches of vascular engorgement. The medullary cones have now shared in the general atrophy, some of them being quite obliterated, while others are contracted and indistinct. These are usually cases in which the disease has been long continued, and has slowly advanced towards a fatal termination.*

In other cases, the unorganized 'waxy' material is deposited in the tubes abundantly, and at an early period of the disease, before the kidney has become much wasted. (Revels, No. 15.) The size and weight may be very little below the average; and in proportion to the quantity of the secondary deposit will be the yellowish-white, firm, and wax-like appearance of the cortical substance. Where the deposit is most abundant, the vascularity is least so; when it is recent, the surface remains smooth, but after a time the deposit contracts, and forms the firm, white granulations, varying in size from a pin-head to a pea, by which the capsular surface of the kidney is often roughened. In cases where the deposit is comparatively scanty, these

* There is no visible difference in the outward appearance of the kidney between those cases in which there has been the true desquamative process, and others in which there has been disintegration of the epithelium without desquamation.

granulations are the only outward indications of its existence. In these cases, too, the wasting of the cortical substance and the secondary deposition may proceed slowly and simultaneously, so that the firm, white, coarse granulations may be found in kidneys reduced to one-half of the normal size and weight. (Brooks, No. 12.) I have seldom seen this deposit in the medullary cones, but I have repeatedly observed that they retain their normal appearance when the cortical substance contains it abundantly.

With reference to the cystic degeneration it may be remarked, that although it may co-exist with all the conditions of the kidney which have been described above, yet that it is least common in the cases of extreme atrophy, for the reason before suggested, that a continuous, general wasting involves the cysts and prevents their growth, while, on the contrary, an arrest or intermission of the primary disease is favourable for the development of the cysts. And, again, the secondary deposit of the 'waxy' material is unfavourable to the growth of cysts, for the obvious reason, that the tubes cannot become dilated by a serous secretion after their cavities have been filled and obliterated by a solid deposit. I look upon the coarse granulations, just now described, as the counterparts of the serous cysts.

Finally, although the disease is frequently somewhat more advanced in one kidney than in the other, yet there is scarcely an exception to the rule that both are affected simultaneously and in like manner.

CONDITION OF THE BLOODVESSELS OF THE KIDNEY.

I have now to describe the condition of the bloodvessels of the kidney, and, in immediate connexion with this subject, to explain more fully than I have yet done, what is known of the proximate cause of the albuminuria and of the dropsy, which are so commonly associated with this and other forms of renal disease. The reason for placing these subjects in juxtaposition will be apparent, when it is seen that they are remarkably illustrative of each other, and that, in particular, the condition of the renal bloodvessels throws much light upon the immediate cause of albuminous urine.*

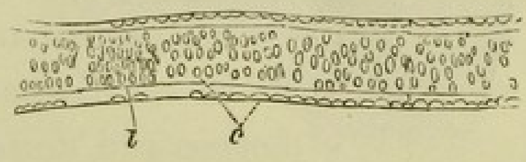
The appearances which I have observed in the bloodvessels are such as indicate an impediment to the circulation through the inter-tubular capillaries and a consequent increase of pressure upon the vessels which, in the order of the circulation, lie behind these. The Malpighian capillaries and the arteries have their coats remarkably thickened, while the walls of the intertubular capillaries and of the emulgent vein present no appearance of hypertrophy or thickening. I will now detail the appearances which I have observed in each set of vessels—viz., the arteries, the Malpighian capillaries, the inter-tubular capillaries, and the veins.

Arteries.—I have observed, in accordance with the

* The substance of what I have to say on this subject was communicated to the Medico-Chirurgical Society, in a paper which has been published in the 33rd volume of the *Transactions.*

description which Henle* has given of the arterial tunics, that the minute branches of the renal arteries have two fibrous coats, the inner being longitudinal, and the outer circular. The inner coat is, in the normal state, much thinner than the outer. The two coats appear to be of the same nature, and, in all probability they are muscular (fig. 18), a conclusion which receives confirmation from the pathological changes which they undergo. The most remarkable and interesting of these changes is hypertrophy of the muscular walls. It affects both layers of fibres; but whereas, in the natural state, the inner layer is considerably thinner than the outer, they are commonly, when hypertrophied, of nearly equal thickness. The thickening appears to be proportionally greater in the smallest arteries—*e.g.*, the afferent vessels of the Malpighian bodies—and gradually diminishes in passing from these vessels towards the arterial trunks. The thickening is not associated with any other structural change; but it appears to be an instance of simple hypertrophy—increased bulk, that is, without change of structure. The cases which are most favourable for examining this condition are those which are marked by extreme wasting and contraction of the

Fig. 18.



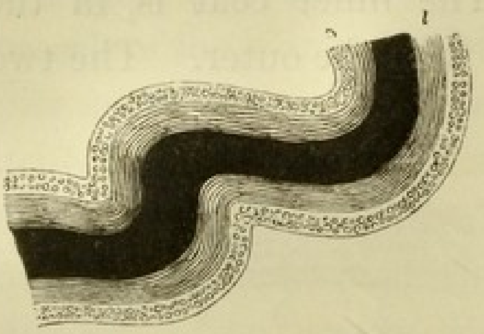
Portion of renal artery in the normal state, showing the relative thickness of the two layers of fibres.

c. Circular fibres.
l. Longitudinal fibres. — *Med. Chir. Trans.* vol. xxxiii.

* *Allg. Anat.*

kidneys; in such instances I have often seen the coats of the arteries at least two or three times thicker than in the normal state (fig. 19). I have frequently observed that the thickened arteries are much more tortuous than the vessels in a healthy condition; and I, at one time, supposed that this might be a consequence of the arteries still retaining their original length, while they are packed within a smaller compass; a necessary result of the wasted condition of the kidney which is frequently associated with the hypertrophied and tortuous condition of the arteries. I have recently, however, observed an extremely tortuous condition of the arteries, with hypertrophy of the walls, in a kidney which much exceeded the normal size, and the weight of which was seven ounces. I am now, therefore, of opinion, that the tortuosity of the arteries is a consequence of the impeded state of the circulation which is associated with extensive disorganization of the secreting tissues. In those kidneys, or in those parts of a kidney, which present the appearances of a less advanced disease, the arterial hypertrophy is either less decided or it may be entirely absent. The canal of the arteries is usually of the normal size, but sometimes there is an appearance of dilatation; it remains pervious, and may readily be

Fig. 19.



Portion of renal artery, showing great hypertrophy of its coats.

c. Circular fibres.
l. Longitudinal fibres. The canal of the vessel is filled with injection.—*Med. Chir. Trans.* vol. xxxiii.

filled with injection until a very advanced period of the disease, when it may often be observed that some of the arteries have oil-globules collected here and there within their canals.

It is nearly certain that the fatty deposition is a consequence and not a cause of the arrest of the circulation, and recent observations render it in the highest degree probable that the oil is a product of the metamorphosis of the stagnant blood which remains in the vessels after the circulation has ceased.*

Malpighian Capillaries.—In connexion with the subject of acute nephritis, I have described the condition of the Malpighian capillaries in cases of recent disease,† the slightest departure from the normal state being an extreme fulness of the vessels; and this going on to produce rupture of the capillaries and hæmorrhage into the tubes; while in other instances it leads to a gradually increasing opacity and thickening of the capillary walls, in consequence of which the blood within them assumes a peculiar aspect and its corpuscles appear magnified. The appearances here alluded to, may occasionally be seen in some parts of a kidney in an advanced stage of chronic nephritis. But the greater number of the Malpighian capillaries will be found to have undergone still further changes. The capillaries in the normal state do not present a

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* Dr. Quain's very valuable paper 'On Fatty Disease of the Heart,' contains some interesting observations on the conversion of protein compounds into fat, both during life and after death.—*Med. Chir.-Trans.*, vol. xxxiii.

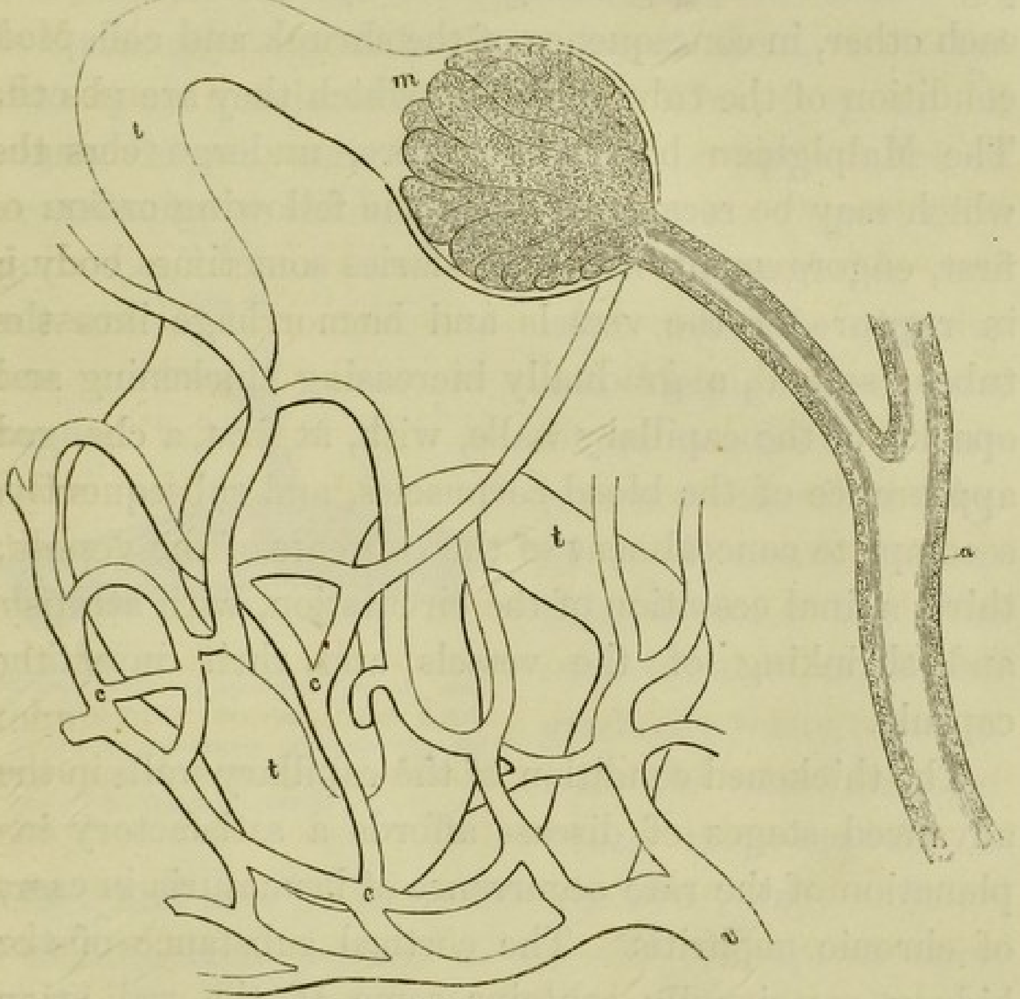
† See p. 101.

fibrous structure, nor is there any appearance of such tissue in the diseased vessels. The coats of the vessels are much thickened, but homogeneous in structure, and the canal is apparently normal, or perhaps slightly narrowed. The injection sometimes fills the Malpighian vessels very completely, in other instances the tuft is only partially filled; and again, in others the injection proceeds no farther than the termination of the afferent artery. The entire Malpighian body is not sensibly enlarged;* but the increased thickness of the capillary walls leads to a close packing and crowding of the vessels, so that their outline can scarcely be distinguished. (Fig. 20, *m.*) The surface of the vessels is usually smooth and free from deposit, and the entire tuft presents a peculiar, whitish, opaque appearance. Sometimes the surface of the capillaries is roughened by an indistinctly granular material, probably of a fibrinous nature, which appears to have coagulated upon the vessels after escaping from their canals, but very rarely is there any appearance of an organized effusion, either fibrous or cellular, within the Malpighian capsule. The addition of acetic acid to the Malpighian vessels in the opaque condition before described will frequently render their walls transparent, so as to show the blood-corpuscles within them; thus proving that many of those Malpighian bodies which, at the first view, appeared to be bloodless, yet contained blood-corpuscles within

* With regard to this point, my observations entirely confirm those of Mr. Bowman and Mr. Busk.—*Phil. Trans.* 1842, p. 67, *Note.*

them, which were concealed by the opaque and thickened capillary wall. Finally, the Malpighian

Fig. 20.



Plan of the renal bloodvessels and uriniferous tube, showing thickening of the artery and Malpighian capillaries, while the inter-tubular capillaries and the vein present no appearance of thickening.

a. Artery.
m. Malpighian capillaries.
c, c, c. Inter-tubular capillaries.
v. Vein.
t. Tube.—*Med.-Chir. Trans.* vol. xxxiii.

bodies become entirely bloodless, the vascular tuft being atrophied and the capsule shrivelled. And occasionally, as in the arteries under like circumstances, small clusters of oil-globules may be seen in the canals or in the walls of the decayed vessels.

The fact that the atrophy of the tubes precedes that of the Malpighian bodies, is shown by an appearance to which I have already alluded*—that of the Malpighian bodies being brought nearly into contact with each other, in consequence of the shrunk and collapsed condition of the tubes amongst which they are placed. The Malpighian bodies, therefore, undergo changes which may be recapitulated in the following order:—first, engorgement of the capillaries sometimes ending in rupture of the vessels and hæmorrhage into the tubes; second, a gradually increasing thickening and opacity of the capillary walls, with, at first, a changed appearance of the blood-corpuscles, and subsequently, a complete concealment of the contents of the vessels; third, a final cessation of the circulation, with atrophy and shrinking of the vessels and their investing capsule.

The thickened condition of the capillary walls in the advanced stages of disease affords a satisfactory explanation of the rare occurrence of hæmaturia in cases of chronic nephritis. The cortical substance of the kidney occasionally contains some of the red spots composed of convoluted tubes filled with blood which has escaped from ruptured Malpighian capillaries. This hæmorrhage rarely occurs in the denuded tubes, but rather in such as are in an earlier stage of degeneration, when the Malpighian vessels have not yet undergone that process of thickening which enables them to resist the increased pressure to which they

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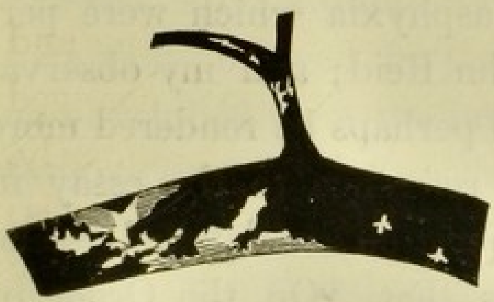
* Page 214.

are subjected in consequence of the impeded circulation.

Inter-tubular Capillaries.—The examination of these vessels gives for the most part a negative result. It is commonly very difficult to inject them, or to see them in an uninjected condition. When they can be clearly defined, their walls present no appearance of hypertrophy or thickening; and in this respect they form a remarkable contrast with the arteries and Malpighian vessels, whose condition I have just now described (fig. 22). It seems reasonable to infer that the inter-tubular capillaries gradually waste, together with the tubes amongst which they are distributed, and it is probable that the two tissues undergo a simultaneous process of atrophy consequent upon the destruction of the epithelial lining of the tubes.

Fig. 21.



Portion of vein and capillaries from the same kidney as fig. 19. *The coats of these vessels present no appearance of thickening; the canal is partially filled with injection.*—Med.-Chir. Trans. vol. xxxiii.

Veins.—The minute branches of the veins are in essentially the same condition as the inter-tubular capillaries. The evidence of their atrophy and obliteration is clearly seen on the capsular surface, where the lobular divisions, which are formed by the minute venous radicles, are more or less completely erased, and the tissue assumes a pale and exsanguine appearance. A microscopic examination of their coats detects no appearance of thickening or hypertrophy (see fig. 21). The larger divisions of the veins are occasionally found shrunk and contracted, and not unfrequently they contain firm coagula of blood, which adhere more or less closely to the walls of the vessels.

THE PROXIMATE CAUSE OF ALBUMINOUS URINE.

The explanation which I have to offer of the phenomena of albuminous urine was first suggested to me by some experiments on asphyxia which were performed by the late Dr. John Reid; and my observations upon this subject will perhaps be rendered more intelligible by a previous reference to the essay in which the experiments in question are detailed. The essay to which I allude is that, 'On the Order of Succession, in which the Vital Actions are arrested in Asphyxia.'* The principal facts and arguments therein contained, which concern us in our present inquiry, are the following:—When the trachea of an animal has been obstructed by the insertion of a tube with a closed stop-cock, dark blood is at first transmitted freely through the lungs, and reaches the left side of the heart, by which it is driven through all the textures of the body. As the blood becomes more venous, its circulation through the vessels of the brain deranges the sensorial functions, and rapidly suspends them, so that the animal becomes unconscious of all external impressions. For about two minutes after

* *Physiological, Anatomical, and Pathological Researches*, p. 17.

the animal has become insensible, and when the blood in an exposed and unobstructed artery is equally dark with that in the accompanying vein, the large arteries become more distended than before the stop-cock in the trachea was closed, and when the animal was breathing atmospheric air. At the same time, a hæmadynamometer being placed in the artery of one limb, and a similar instrument in the corresponding vein of the other, the former indicates an increase, and the latter a diminution, of pressure, as compared with that observed in the same vessels before the air was excluded from the lungs; this evidently resulting from an impediment to the passage of black, unaërated blood through the systemic capillaries. At the expiration of the time before mentioned—viz., about two minutes, the instrument in the artery indicates a diminution of pressure; the mercury at first falling slowly, and afterwards very rapidly, in consequence of the blood being arrested in the pulmonary capillaries, and so accumulating in the right side of the heart, and in the veins. If now the stop-cock be opened so as to admit fresh air into the lungs, they instantly transmit the blood which was before stagnant within them, and the arterial instrument again shows an increase of pressure upon the walls of the vessel.

Dr. Reid then quotes some observations by Dr. Alison,* tending to show that the arrest of the blood in the pulmonary capillaries, is to be referred to an interesting law in physiology, in accordance with

* *Pathology and Practice of Medicine*, p. 120.

which, the movement of nutritious juices is influenced by the chemical changes, or, as Dr. Alison says, 'the vital attractions, connected with the chemical changes constantly going on in the capillary vessels, between these juices and the surrounding tissues, by which nutrition and secretion are effected. Before arterial blood can be transmitted freely through any tissue or organ, it is necessary, not only that the contractions of the heart be performed with a certain amount of force, but that the actions of nutrition and secretion be also in operation; so, in the same manner, before the blood can be transmitted through the lungs, it is not only necessary that the right side of the heart retain its contractility, but that the chemical changes between the blood and the atmospheric air should proceed.' This doctrine is still further illustrated by Dr. Reid's experiment, just now described, which demonstrates that when the blood in the systemic circulation becomes decidedly venous, and consequently unfit for carrying on the process of nutrition, it passes less freely through the capillaries into the veins.

The observations and inferences of Drs. Reid and Alison seem to be applicable, by way of analogy, to the subject of renal disease, and will assist us in our attempt to ascertain the immediate cause of the albuminuria and the dropsy, which are so commonly associated with diseases of the kidney.

Assuming that the renal circulation is affected by an imperfect elimination of the urinary constituents in a manner analogous to that in which the pulmonary circulation is influenced by the retention of carbonic acid in the blood, we should expect to find that the circulation would first be retarded in the inter-tubular capillary vessels. The obstruction, which would be in proportion to the extent of morbid change in the contiguous tubes and cells, would, of course, exert an influence extending backwards in the order of the circulation, so that the Malpighian capillaries, and the arteries which supply them, would become gorged with blood; this engorgement being exactly analogous to that of the right side of the heart and of the venous system in animals after death from asphyxia.

There are certain facts which afford a remarkable confirmation of that which, as just now propounded, might seem to be a mere hypothesis, or, at best, only a probable analogy.

That the circulation through the inter-tubular capillaries is retarded, and that the Malpighian capillaries are consequently subjected to a greatly increased pressure and distension, would seem to be indicated by the escape of serum and blood which so constantly occurs during an attack of acute desquamative nephritis. There appears no reason to doubt that these materials escape from the Malpighian capillaries which lie uncovered and unsupported within the dilated ends of the tubes. The Malpighian vessels present the peculiar appearances, before described, as connected with the transudation of serum, and frequently the capsule is filled with blood which has escaped from the ruptured vessels within it. The only vessels besides these, from which the hæmorrhage could possibly occur, are the inter-tubular capillaries, and it is little less than certain that these are not the source of the hæmorrhage. For, first, the rupture of these vessels must, of necessity, be associated with some inter-tubular extravasation, which is so rare an occurrence, that I do not remember to have seen it once; and, secondly, the blood could not escape from the inter-tubular capillaries into the tubes without passing through the thick and firm basement membrane of the tube, which never, in cases of acute nephritis, presents any appearance of tearing or perforation.

But still more satisfactory and conclusive evidence of impeded circulation, and of the precise point at which the impediment occurs, is afforded by the condition of the renal bloodvessels in cases of chronic nephritis. It is clear that the only explanation which can be given of the state of the bloodvessels which I have described, is, that the blood is impeded in its passage through the inter-tubular capillaries. The impediment reacts backwards upon the Malpighian capillaries, the coats of which gradually become thickened by a preservative process of hypertrophy, which seems intended to enable them to bear the increased pressure to which they are subjected. Simultaneously with these changes in the Malpighian capillaries, the muscular walls of the arteries become hypertrophied, so as to assist in driving the blood onwards through those vessels in which the impediment exists. This hypertrophy of the arterial walls, is one of the best proofs that the minute arteries assist in carrying on the circulation. The tortuosity of the arteries, which is almost constantly associated with the hypertrophy of their walls (p. 230), and the dilatation of the canals, which may occasionally be observed, are amongst the consequences of the impeded condition of the circulation, and they afford evidence that an impediment actually exists.

It is evident that the obstruction exists in the inter-tubular capillaries; it cannot be in the trunks of the veins, for, in that case, the inter-tubular capillaries would be distended, and perhaps ruptured, during an acute attack; and, as a result of chronic disease, their walls would become thickened like those of the Malpighian capillaries, the contrary to which is invariably the case. And, again, that the impediment is in front of the Malpighian capillaries, and not in them, appears to be sufficiently proved by the great distension and rupture of these vessels in acute nephritis, and by their canals remaining pervious while their walls become thickened in consequence of chronic disease. The fact that the arterial coats and the Malpighian capillary walls undergo a similar process of hypertrophy, modified only by the natural difference in their structure and functions, is additional evidence that both sets of vessels are alike behind the seat of obstruction, which, I repeat, must be in the inter-tubular capillaries.

The hypertrophy of the renal arteries is analogous to that of the right ventricle of the heart, occurring, as it so commonly does, in connexion with emphysema of the lung and chronic bronchitis. In these cases there appears to be an impeded circulation through the pulmonary capillaries, consequent upon long-continued imperfect aëration of the blood; and hypertrophy of the right ventricle is a natural result of this impediment.

I am anxious to avoid any hypothesis as to the actual and immediate cause of the obstruction, whether spasm of the vessels, or adhesion of the blood to their walls, or the diminution or suspension of any attractive influence which the gland-cells may be supposed to exert upon the circulating fluid. The data which we possess are insufficient for determining this point, and it appears impossible, at present, to do more than simply associate the phenomena of obstructed circulation with such an altered condition of the gland-cells as interferes with the prompt and complete purification of the blood. We have already seen that a morbid condition of the epithelium is the first in the order of phenomena, and that the urine does not become albuminous, nor is there any other sign of great congestion of the kidney, until the disease of the cells is so extensive as to be incompatible with a due performance of their functions. The blood is sent to the cells for the purpose of giving up certain of its constituents, and until it has done so it is not permitted to pass freely onwards. And, finally, when the cells have been entirely destroyed and removed, the circulation ceases, and the tubes and vessels undergo a process of wasting—a natural result of their loss of functional power.

The escape of serum from the Malpighian vessels, and the frequent occurrence of hæmorrhage into the tubes, are natural and intelligible consequences of an impeded circulation through the inter-tubular capillaries. Dr. Robinson* obtained this result experimentally by placing a ligature on the renal vein of a rabbit; in consequence of which the urine became albuminous and bloody. He performed this experiment several times, and with an almost uniform result. Frerichs† has repeated Dr. Robinson's experiments with a similar result, and, in addition, he observed, what might have been anticipated, that the urine which was albuminous and bloody contained fibrinous casts of the kidney tubes. It is not probable that the escape of these materials from the Malpighian capillaries is a merely physical process of transudation, but rather that it is the result of a secretory effort to relieve the over-distended vessels.

In the abundant secretion of albumen which attends all the forms of renal disease which have their origin in a morbid state of the blood, consists one remarkable difference between the diseases of the kidney and those of the liver; an albuminous condition of the bile being an extremely rare occurrence. The explanation of this diversity is to be found in the fact, that the kidneys, unlike the liver, have two sets of capillary vessels. The inter-tubular capillaries correspond with the capillaries of the liver; they are the immediate seat of the obstruction which occurs as a consequence of disease in the secreting cells, and the escape of serum from the Malpighian capillaries is a natural and necessary consequence of that obstruction. If the kidneys were not provided with the Malpighian bodies in addition

* *Med.-Chir. Trans.* vol. xxvi. † *Op. cit.*, p. 276.

to their other vascular apparatus, there is reason to believe that the urine would contain albumen and blood as rarely as the bile is found to do.

The convoluted tubes of the kidney resemble, in the thickness of their epithelial covering, the *mucous* membranes, whose diseased conditions are not ordinarily attended by a decidedly albuminous secretion. And when the inflammation of a mucous membrane leads to the formation of pus, or the escape of blood, the albumen, which forms a constituent part of these products, is rarely so abundant as to render the secretions coagulable in the same degree as the urine commonly is in cases of renal diseases which are unattended with suppuration or hæmorrhage.

While the convoluted tubes and the *mucous* membranes resemble each other in the before-mentioned particulars, there is, in some respects, a close analogy between the Malpighian bodies and the *serous* membranes. For whereas the Malpighian capillaries are entirely bare within their capsule, the bloodvessels of serous membranes are covered only by tissues of extreme delicacy and tenuity, through which the serum of the blood transudes with great facility, as may be seen in the albuminous effusions, whether dropsical or inflammatory, which are found in the cavities of serous membranes. And with reference to this point it is not without interest to observe, that whereas the thick covering of glandular epithelium in the convoluted tubes appears to prevent an albuminous effusion through this portion of the renal tissues, yet when, as a consequence of disease, the epithelium has been removed, leaving the basement membrane denuded, or covered only by the delicate transparent cells which I have before described, so that the tubes are, in fact, brought into the anatomical condition of a serous membrane—in these circumstances, the liquid contents of the tubes, or rather of the cysts which are developed from them, are found to be more or less albuminous.

When describing the condition of the urine in different stages of chronic nephritis, I stated that, in the later periods of the disease, the quantity of albumen is sometimes small; a fact which is easily explained by reference to the successive changes in the renal bloodvessels which I have already described, beginning with great engorgement and ending with a complete arrest of the circulation, and atrophy of the vessels. It is evident that, *cæteris paribus*, the amount of albumen will be in proportion to the number of bloodvessels whose over-distension leads to the escape of the serous part of the blood, and that a diminution of the albumen is a natural consequence of the atrophy and obliteration of the vessels which occur so generally in the advanced stages of the disease. It is not impossible that the thickened condition of the Malpighian capillaries may offer some impediment to the free escape of serum, but as I have several times seen the urine highly albuminous in connexion with extreme thickening of these vessels, I believe that a diminution in the number of Malpighian bodies, is more influential than thickening of the capillary walls, in lessening the secretion of albumen.

THE PROXIMATE CAUSE OF DROPSY.

With reference to the subject of renal dropsy, analogy would suggest the very great probability that it is the result of an impeded circulation through the systemic capillaries, consequent upon the retention of the urinary constituents in the blood, and that the obstruction thus originating, is similar to that which Dr. Reid detected by the hæmadynamometer, when black, unaërated blood was circulating through the arteries and the systemic capillaries of the animals which were the subjects of his experiments. There is one fact which, *per se*, is almost sufficient proof that the systemic capillary circulation is actually impeded in the way supposed, in consequence of an incomplete elimination of the urinary constituents. I allude to the frequent occurrence of hypertrophy of the left ventricle of the heart in cases of chronic renal disease, when there is no disease of the valves or large vessels to account for such hypertrophy.

I have already given the statistics of Dr. Bright's cases (p. 204), and I have referred to his suggestion, that one of two explanations which may be given of the complication in question is, that the altered quality of the blood 'so affects the minute and capillary circulation, as to render greater action necessary to force the blood through the distant subdivisions of the vascular system.' The probability of there being an obstruction of the kind suggested, is scarcely lessened by the occurrence of a certain number of cases of chronic renal dropsy in which the left ventricle is not hypertrophied, for a contrary conclusion would as little apply to these cases as to cases of actual disease of the valves. It would be an error to suppose that narrowing of the aortic orifice is not a real impediment to the onward passage of the blood, and a cause of the associated hypertrophy, because in some cases, with an equal narrowing of the orifice, the ventricular walls do not exceed their normal thickness. The absence of hypertrophy is, in such instances, the result of defective nutrition of the muscular substance of the heart, and an unfavourable circumstance for the patient, whose life would probably have been prolonged by the aid of the compensative process in question.

It may readily be supposed, that if Dr. Reid's experiments could have been indefinitely prolonged upon one or more animals, the impeded capillary circulation and the increased pressure upon the arterial walls would have been associated with hypertrophy of the left ventricle; and I repeat, that such hypertrophy, without imperfection of the valves or large vessels, when found in conjunction with chronic renal disease, is important evidence of impeded capillary circulation consequent on a morbid condition of the blood, and that the impediment is analogous to that which Dr. Reid has demonstrated in the case of asphyxia.

The existence of capillary obstruction being admitted, dropsical effusion appears to be a natural and necessary consequence. It follows, too, that an albuminous condition of the urine, and dropsical effusion into the areolar tissue and serous cavities, must result from strictly analogous conditions—viz., an arrest of poisoned blood in capillary vessels, and a consequent effort to remove engorgement and over-distension of the vessels by a process of serous secretion or transudation through their walls. It should never be forgotten, that each step in the series of morbid phenomena has a beneficial tendency, and that the free transmission through the systemic capillaries of blood which is unfit for the nourishment of the tissues, would probably be a greater evil than the dropsical effusion which results from the retarded circulation.

If my explanation of those cases of dropsy which result from a morbid state of the blood should be found correct, it will be seen that there is one point of agreement between all forms of dropsy, which is this —that an impeded circulation precedes and accompanies, and is, in fact, the proximate cause of the dropsical effusion. When an abnormal condition of the blood is the primary cause of the dropsy, the impediment exists in the capillaries themselves, but when disease of the heart or liver, or pressure on a venous trunk, is the originating cause, the obstacle acts through the veins upon the capillaries, which consequently become gorged, and from them, as in the other class of cases, the effusion takes place.

It may be useful to take a collective view of the phenomena to which allusion has been made, in order to see the analogy between them, and to obtain the benefit of such light as they are found to reflect upon each other.

First, then, it is an important physiological and pathological law that the blood, in order to circulate freely through the capillaries, must be in a normal condition, and that any departure from its healthy composition is associated with more or less of impediment and retardation in the capillary circulation. And further, it appears that when the abnormal condition of the blood results from the retention of some excrementitious materials, while the impediment of the capillary circulation is general throughout the system, it is greatest, and finally most complete, in the capillaries of that particular organ whose office it is to eliminate the materials in question. In cases of asphyxia, for instance, the retained carbonic acid, while it retards the entire systemic circulation, finally effects a complete stoppage in the capillaries of the lungs; and in like manner, the retention of renal excrement, while it leads to a general systemic capillary congestion, produces the greatest impediment of the circulation in the kidneys themselves. Another point of agreement between the cases referred to, is the occurrence of hypertrophy of the muscular tissues which are immediately concerned in carrying on the circulation, and which are impelled to increased action by the impeded capillary circulation. Thus chronic diseases of the lung, such as emphysema and bronchitis, so interfere with the aëration of the blood as to impede the pulmonary circulation, and consequently the right ventricle of the heart very commonly becomes hypertrophied.* In an analogous manner, such diseases of

* I have not particularly examined the minute branches of the pulmonary arteries in cases of emphysema and chronic bronchitis; but it appears in the highest degree probable that their walls will be found hypertrophied, like those of the renal arteries after chronic disease of the kidney.

the secreting tissues of the kidney as interfere with the excretion of urine, produce a retarded renal circulation, and consequently hypertrophy of the arterial walls.

Again: the impediment to the systemic circulation consequent upon the morbid state of the blood, is shown in the case of chronic renal disease by the occurrence of hypertrophy of the left ventricle of the heart, and a like result often follows the long continuance of asthma, emphysema, or bronchitis, while the effect upon the systemic circulation of a *sudden* arrest of the respiratory functions is shown in Dr. Reid's experiments.

There is yet another phenomenon which is common to all these instances of obstructed circulation, and that is, the escape of serum from the congested vessels, the result of an effort to relieve them in some degree of their over-distension and engorgement.

In the kidneys the serum escapes from the Malpighian capillaries into the tubes, and so, being mixed with the urine, renders it albuminous. In the case of the lungs the air-cells become gorged with the effused serum, and this is a constant result of slow asphyxia, whether produced by disease, or accident, or by experiment. It is often seen in connexion with such diseases of the lung or pleura as greatly impede the respiratory functions; it may occasionally be observed in cases of accidental injury of the spine, producing paralysis of the respiratory muscles, and it was repeatedly witnessed by Dr. Reid* as a result of division of the pneumogastric nerve.

* *Op. cit.* Fourth Essay 'On the Eighth Pair of Nerves.'

And again, the systemic capillary congestion which results from a poisoned condition of the blood, leads to the effusion of serum into the meshes of the areolar tissue and into the serous cavities. In the cases of chronic pulmonary disease, it is impossible to estimate separately the influence of impeded pulmonary circulation consequent upon defective respiration, and that of the slow and difficult transit of imperfectly aërated blood through the systemic capillaries. It is, however, little less than certain that both conditions concur in producing the general dropsy, which is often associated with such forms of pulmonary disease, even when they are not complicated with renal disease, or with valvular disease of the heart.

It is not every deviation from the normal condition of the blood which so interferes with the capillary circulation as to produce dropsy. General dropsy is a rare consequence of the retention of bile in the blood, if, indeed, it ever originate from that cause. It is a more frequent result of renal disease, for the reason that the urine when retained in the blood is more noxious than the bile, and because the kidneys are the chief outlets for water. It is impossible accurately to define the conditions required for the production of dropsy. A scanty discharge of liquids by the kidneys, and a watery condition of the blood, are undoubtedly favourable for its occurrence. And yet it may be entirely absent when there is extreme anæmia with a scanty discharge of urine, as in the case of Hewson (No. 11), and, on the contrary, it may come on rapidly, and in a great degree, at the very commencement of the renal disease, before the blood has been impoverished by the destruction of its colouring matter, or the loss of its albumen. It may also be present in the advanced stages of chronic nephritis, when the daily discharge of water by the kidneys greatly exceeds the normal amount.

Notwithstanding these apparent anomalies, I believe it will generally be found that the risk of renal dropsy is in proportion, first, to the amount of urinary excrement retained in the blood; secondly, to the rapidity with which the accumulation occurs; thirdly, to the relative quantity of water in the blood; and, fourthly, to the amount of liquid discharged by the kidneys inversely—the greater the quantity of liquid discharged the less the risk of dropsy. In confirmation of the last statement, I may refer to the fact, which I have before mentioned, that chronic desquamative nephritis, which is characterized by the secretion of an amount of urine often excessive throughout all its stages, and rarely scanty, except at the very termination, is also that form of disease which, much more frequently than any other, runs its entire course without the occurrence of dropsy in any form or degree.

A reference to the case of Addis (No. 16, *Remarks*) will show that there may be an impeded capillary circulation, as indicated by a very marked hypertrophy of the left ventricle, without the occurrence of dropsy. It is probable that an equal degree of impediment to the circulation, with a more watery condition of the blood, would have produced a dropsical effusion.

Some degree of dropsy resulting from an excessive proportion of water in the blood, is frequently seen in cases of chlorosis and of anæmia after hæmorrhage. In such instances a greater or less degree of œdema of the subcutaneous tissue is a very common occurrence. It appears probable that the palpitation and dyspnœa, by which anæmic patients are so frequently distressed, are the result, not merely of a flabby and enfeebled condition of the heart, but of some actual impediment to the passage through the capillaries of the watery blood, unfit as it is for the nourishment of the tissues. It is impossible to estimate separately the influence which the heart's weakness and the impeded circulation of watery blood may have in causing the dyspnœa and palpitation and the dropsical effusion. The administration of steel, which restores to the blood its normal constituents, at the same time gives strength and energy to the muscular substance of the heart.

It is likely that the circulation through almost every internal organ, is more or less affected by the morbid state of blood consequent upon the imperfect excretion of urine. With our present imperfect knowledge we cannot see why, in different cases, one or more organs should suffer much, while others are comparatively unaffected; nor can we trace the steps by which a morbid state of the blood so affects the nutrition of a tissue, as at first, perhaps, simply to obstruct the capillary circulation, then to produce a serous effusion, and finally all the phenomena of inflammation, with the formation of lymph or pus.

I have already alluded to the occurrence of functional disorder of the brain as amongst the most frequent and serious of the secondary consequences of renal disease, although it is rare to find any more decided structural change than a slight serous effusion or simple vascular congestion of the brain or its membranes, with only an occasional extravasation of blood. It is in the highest degree probable that all these phenomena are associated with, and perhaps originate in, an impeded circulation through the cerebral capillaries, analogous to that which has been shown to exist in the systemic capillaries elsewhere, and consequent upon the blood being unfitted for the nutrition of the organ in question. It is not possible to tell in what manner carbonic acid and urea disturb the functions of the brain and produce apoplectic symptoms, but it is conceivable that their accumulation in the blood may lead to serious and even fatal mischief, simply by retarding the passage of the blood through the cerebral capillaries; and it is probable that a serous or sanguineous effusion may result from such an obstruction by a process strictly analogous to a dropsical effusion elsewhere, or to the escape of serum and blood from gorged Malpighian capillaries. It is by no means proved, though very commonly assumed, that the pressure of the effused liquid is a source of mischief in cases of so-called serous apoplexy. It is difficult to believe that such pressure can be very injurious after witnessing some cases of chronic hydrocephalus, in which, by an accumulation of liquid, the brain has been spread out into a film, still retaining its functional power apparently unimpaired. And since the most urgent cerebral symptoms may occur in connexion with renal disease without any liquid effusion, it appears very probable that the disordered and impeded capillary circulation is a more constant and efficient cause of mischief.

There are three conditions which favour the occurrence of cerebral hæmorrhage in connexion with renal disease. 1st. An opaque and apparently brittle condition of the small vessels, probably induced by the morbid condition of the blood. 2nd. An impeded capillary circulation resulting from the blood being poisoned, and therefore ill-adapted for the nutrition of the brain. And 3rd. Hypertrophy of the left ventricle of the heart, the result of impeded capillary circulation, and a cause of increased pressure upon the walls of the vessels. The doubts which I have suggested as to any great mischief resulting from the pressure upon the brain of effused serum are, of course, not applicable to the case of sanguineous effusion, which is a much more formidable accident, and rarely, if ever, unattended by serious consequences.

It will be apparent, from the foregoing considerations, that the subject of impeded capillary circulation, resulting from a morbid state of the blood, and the effusions consequent upon it, is one of great interest. The further investigation of the subject, with reference to other diseases, and with the aid of analogy, will probably throw light upon many obscure pathological phenomena.

It will, of course, be understood that the observations which have been made on the subjects of albuminous urine and renal dropsy are applicable to all the forms of renal disease. I have entered upon a full consideration of them in immediate connexion with chronic nephritis, because the morbid anatomy of that disease affords remarkable confirmation of the doctrine which I have advocated.

DIAGNOSIS AND PROGNOSIS.

Returning now from more general considerations to the particular subject of chronic nephritis, before entering upon the treatment, I will offer a few remarks with reference to the diagnosis and prognosis of the disease. As the two subjects are very intimately connected, it will be better to treat of them together under one head, than to make a formal separation of them; and what I have to say upon these points will be chiefly a reference to, and a repetition of, some matters which have been more fully treated of in previous parts of this chapter; for it will be apparent that a sound judgment in diagnosis and prognosis can be based only upon an extended consideration of the entire history of a disease.

It has already been shown that chronic desquamative nephritis consists essentially in a shedding of renal epithelium, which appears in the urine in a more or less disintegrated state. A microscopic examination of the urine is the best and only certain means of ascertaining the nature of the epithelial deposit. With reference to the prognosis, it is important to distinguish between acute and chronic desquamation, and this may be done by observing, first, that in the acute disease the epithelial cells are, for the most part, entire, while in the chronic form they are mostly disintegrated (p. 178); and secondly, that the urine of acute nephritis almost always contains blood-corpuscles, while that of chronic nephritis rarely does so (p. 187). The transition from acute to chronic nephritis is indicated by the disappearance of the blood-corpuscles, and the replacing of entire by disintegrated epithelium, whether scattered about the field or entangled in the casts. I once mistook some casts, which had a granular appearance, and which were composed of disintegrated blood, for granular epithelial casts. They existed in the urine of a man who had been very ill nourished, and who had some symptoms of purpura. The urine was not coagulable by heat or nitric acid, but the casts were very numerous. The patient rapidly recovered under the influence of a nutritious diet; and in a few days the urine was entirely free from sediment. I have since ascertained that I might have distinguished these casts from disintegrated epithelium by observing the peculiar yellowish-brown colour which is characteristic of disintegrated blood, and which epithelium rarely, if ever, has.

The quantity of disintegrated epithelium in the urine is a pretty accurate measure of the rate at which the disease is progressing. The desquamative process is accelerated during a gouty paroxysm, or as a consequence of some local inflammations; when these have subsided, the epithelial deposit again diminishes. Unless this fact is borne in mind, a too unfavourable prognosis might be deduced from an examination of the urine during the temporary increase of the epithelial deposit by one of the above-mentioned causes. It must be remembered, that the sediment, as seen by the naked eye, may be increased by the mixture of pavement epithelium from the bladder or other parts (p. 188), and care must be taken lest this prove a source of error in estimating the progress of the disease.

A very important element in the prognosis is a knowledge of the *stage* of the disease and of the degree and extent of structural change in the kidneys. This knowledge can be derived only from a careful investigation of the entire history of each case, and particularly from an examination of the chemical and microscopic characters of the urine. The probable duration of the disease, as inferred from the history of past symptoms, is, in most instances, an unsafe guide, as well on account of the insidious manner in which the disease often advances, as of the great variations in its rate of progress, so that of two cases of apparently equal duration, the disease in one may be much more advanced than in the other. This mode of investigation, however, must not be neglected, for although, taken alone, it is not much to be relied on, yet the information derived from it is of great value in connexion with other signs.

In the examination of the urine its chemical and microscopic characters must be compared, and the results of one mode of investigation corrected by those derived by the other, as, in the physical examination of the chest, the evidence which is derived from percussion and from auscultation respectively.

When the disease is chronic from the commencement, the appearance of the granular casts affords the earliest indication of its existence. The casts in the early stages are often few in number, and become more abundant as the disease advances.

The albumen appears at a later period, when the destruction of epithelium has become more extensive, so that secretion and circulation are much retarded. As the disease advances, the granular casts and the albumen simultaneously become more abundant, both being subject to a temporary increase during the existence of any local inflammation of the joints or other parts, and both being usually most abundant during the middle stages of the disease. At a later period the albumen frequently diminishes, and sometimes, but rarely, it may for a time entirely disappear. The granular casts also diminish in number, so that the sediment often becomes very scanty, and the granular casts are mixed with, or sometimes entirely replaced by, 'large waxy casts' in variable numbers. During the progress of the disease the urine becomes abundant, and gradually loses its density and its colour. A very advanced state of disease is indicated by pale, almost colourless, urine, rather small in quantity, more or less albuminous, with a scanty sediment containing 'large waxy casts.' These appearances have been referred to and explained in the description which I have given of the characters of the urine and the morbid conditions of the kidney.

It is apparent, on a slight consideration of the subject, that the prognosis will be favourable in proportion as the disease is at an early stage, its progress slow, its secondary consequences few and unimportant, and its causes such as may be avoided or neutralized by treatment.

Enough has already been said upon the two first-mentioned points; but it may be useful to make a few remarks with reference to the two last.

The most formidable of the secondary diseases are those which affect the nervous centres. The occurrence of coma or convulsions in connexion with chronic renal disease is always most alarming, and the premonitory symptoms of these attacks should be anxiously watched, and, if possible, removed.

Inflammation of the serous membranes is another serious complication which often leads to a rapidly fatal termination; peritonitis being generally a more formidable and fatal disease than either pericarditis or pleurisy. The existence of valvular disease of the heart is a very unfavourable circumstance; but simple hypertrophy, without valvular disease, is, for the reasons before given, rather beneficial than otherwise, and is only so far an unfavourable sign as it is in some degree an index of the amount of obstruction to the circulation occasioned by the morbid condition of the blood.

A greatly congested or an inflammatory condition of the lung, is a complication scarcely less serious than that of valvular disease of the heart.

Disease of the liver, too, is amongst the complications which diminish the probability of recovery. It is often especially embarrassing, by increasing the tendency to an extreme degree of ascites, which, in its turn, impedes the circulatory and respiratory functions. A great degree of dropsy, in any of its forms, is a distressing and unfavourable symptom, dropsy of the chest being more so than that of the abdomen, while an anasarcous swelling occasionally ends in erysipelatous inflammation, with sloughing of the skin and cellular tissue. Obstinate vomiting and diarrhœa are serious symptoms, often associated with a more or less complete suppression of urine, so that the stoppage of this vicarious discharge sometimes leads to still more formidable symptoms, while its continuance interferes with the nutrition of the body, and often ends in fatal exhaustion.

It is very important to know and to bear in mind, that while the presence of one or more of the complications alluded to, is an unfavourable circumstance and against the patient's recovery, yet their absence is not necessarily an indication of safety, when the characters of the urine are such as point to advanced and extensive disease in the kidney. For the renal disease may have reached its latest stage without the occurrence of any urgent or prominent symptoms, when suddenly, in consequence of some imprudence in diet, or from exposure to cold, the kidneys cease to act, and the patient is seized with the most alarming symptoms consequent upon suppressed secretion.

A great diminution in the quantity of urine, and particularly in the proportion of its solid constituents, must always be looked upon as an unfavourable and alarming circumstance. The history of renal disease shows, indeed, that a very great diminution from the natural standard may take place without the immediate occurrence of urgent symptoms; patients living, according to Dr. Christison, 'in the comfortable enjoyment of tolerable health, though the amount of solid excretion by urine is diminished to fully one-third of the natural daily discharge.' 'Seldom, however,' according to the same authority, 'does the quantity fall to one-fourth without the occurrence of troublesome secondary disorders; and any material reduction under that amount is speedily followed by urgent symptoms, most generally by drowsiness, leading on to stupor and coma.'

With reference to the causes of renal disease as influencing prognosis, it may be remarked that those cases are most favourable which originate from avoidable influences, whether from free living or excessive mental or bodily labour or anxiety, or from the influence of a particular locality or climate; because, if the disease is yet in an early stage, it is likely to cease with the removal of the cause and under the influence of appropriate treatment: whereas, on the contrary, when the disease has resulted from, and is maintained by the influence of, such causes as the patient has not the will or the power to escape from, the probability of recovery is greatly lessened. Confirmed habits of intemperance, great and long-continued mental depression, unavoidable fatigue and anxiety, and the exhausting influence of hereditary or confirmed constitutional disease or weakness, are amongst the circumstances which are least favourable for the patient's recovery. It should be remembered that the form of disease now under consideration has a greater tendency to a favourable termination than any other chronic renal disease. Each step in the series of morbid changes has a wholesome tendency to remedy some antecedent evil. The growth of the tubes into cysts is, perhaps, the only exception to this general rule, and it rarely happens that their development is attended by serious consequences. When the disease in the kidneys has advanced so far that it cannot be entirely removed, it is quite possible that, by judicious management, life may be prolonged for a very considerable period.

TREATMENT OF CHRONIC NEPHRITIS.

The general principles by which the treatment of chronic nephritis should be regulated are essentially the same with those which are available in the treatment of the acute form of disease; but the particular remedies, and their mode of administration, will, of course, be modified according to the stage of the disease and the character of the symptoms. When the causes of the disease can be ascertained, it is clearly of the first importance that the patient should avoid them if possible, and that he should be fortified against them when they are of such a nature that he cannot escape from them. This principle of treatment, thus broadly stated, may perhaps appear vague, but in its application to practice and to the management of particular cases it becomes very precise and definite. It is one which there is reason to believe is too little regarded in the treatment of this as of other diseases, and hence much of the uncertainty which prevails as to the curability of disease and the effect of remedies.

The treatment of chronic nephritis, in most cases, resolves itself into the adoption of means for the removal of that morbid state of the blood, and of the constitution generally, of which the renal disease is only a secondary consequence and a manifestation.

When the gouty diathesis has become complicated with renal disease, the two objects of primary importance are, to prevent, as far as possible, the further increase of the gouty poison, and to favour the elimination of that which is already contained in the blood. The first object will be best attained by the careful regulation of the diet; and the second, by strict attention to the various excretory functions, and the use of such remedial measures as are indicated by the patient's general condition and state of health.

The food should be of the plainest and most digestible kind, taken in moderate quantities and at regular intervals. The dyspeptic symptoms which are amongst the most frequent consequences of renal disease would indicate the necessity for caution as to the quantity and quality of the food, even if the gouty diathesis were not acknowledged to be a form of dyspepsia or mal-assimilation. Animal food may be taken once or twice in the day, when there are no secondary feverish, or inflammatory symptoms which contra-indicate its use. Those who are familiar with gout as it exists amongst hospital patients, know well that the most unmanageable and hopeless cases are those occurring in the persons of poor men, who have been so far crippled by the disease as to be unable to provide themselves with sufficient nourishment, and especially with a due supply of animal food. In this respect there is a strict analogy in the operation of gout and other morbid poisons, such as marsh malaria, or the syphilitic poison, which generally exert a more destructive influence upon a previously unhealthy or enfeebled frame, and which often remain latent and innocuous until the vital powers of resistance are lessened by the reduction of the bodily strength. The principles of treatment which are deducible from these considerations are of much importance, and they must never be lost sight of in the management of renal disease. The patient may take as much food as he can well digest, and of such kinds as are at the same time most agreeable to him and most readily digested. This rule will of course admit of the food varying in different cases, according to the taste and digestive powers of the patient. Vegetable food should be taken in moderate quantities, and pastry must generally be avoided; the first being essential for the preservation of health, and the second rarely fulfilling one of the required conditions—viz., that of being readily digested. With reference to the subject of diet in cases of renal degeneration, Dr. Prout remarks: 'All the barbarous crudities which a vitiated appetite or depraved taste has introduced into modern cookery, should, without exception, be avoided; for whatever affects the stomach is sure to exert an unfavourable influence on the urinary organs. It is impossible to lay down rules which shall be universally applicable; but if the patient confines himself to mutton, poultry, and some of the lighter kinds of fish, among animal matters; and of farinaceous substances, such as bread, rice, sago, &c., together with the occasional use of the lighter herbaceous or leguminous substances, he can scarcely go wrong. In most cases, also, it will be proper to abstain from sugar.' These rules as to the food are applicable to all the forms of chronic renal disease, whatever may have been the cause from which they have originated. With respect to drinks, as a general rule, the less of any kind of fermented liquors there is taken the better. This is a point of great importance in the management of gouty cases, in which malt liquors and most kinds of wine are absolutely poisonous, for they aggravate the dyspepsia and increase the quantity of gouty products in the blood; and at the same time, by their diuretic influence, they direct these poisonous materials to the kidneys, and so add to the renal mischief. There are cases in which it may be beneficial to depart from this general rule of abstinence from fermented liquors. In the early stages of chronic renal disease unconnected with gout, a moderate quantity of genuine beer or of sound wine is sometimes useful as a tonic. And in other cases, when the patient has been long addicted to the excessive use of alcoholic drinks, it may be prudent not to withdraw them suddenly or entirely.

It is of the greatest importance, through all the stages of renal disease, to avoid exposure to cold and vicissitudes of the weather. The clothing must be warm, and flannel should be worn next the skin throughout the year. Confinement in bed or in the house, which is so important in the treatment of acute nephritis, is not desirable in cases of chronic renal degeneration, unless when some secondary disease renders such a measure necessary. When the weather permits, the patient should take moderate exercise in the open air, avoiding over-fatigue and exposure to cold or wet. He may walk or ride on horseback, or in an open carriage, according to his strength and his means. Easy travelling by sea or by land is amongst the most important means of restoring health in the early and even in the more advanced stages of chronic renal disease; and it is especially useful when the health has given way under the influence of grief, or anxiety, or of excessive labour, whether mental or bodily. The following case, reported in a clinical lecture by Dr. Christison,* is a good illustration of the benefit to be derived from a sea voyage:—

'A medical friend, of the age of thirty-eight, was seized with hæmaturia, in July, 1846, and even when there was no blood present he always found the urine coagulable. He had many symptoms of declining health and strength, but no œdema. He was of a consumptive family. Dr. Christison, who was consulted two months after the commencement of the illness, advised repeated blisters over the loins, the

* *Edinburgh Monthly Journal*, June, 1851.

warm bath, a rather generous diet without stimulant liquors, and a pill of lead and opium, or gallic acid. On the 1st October, he reported that he had derived no benefit from the blisters or opium and lead; but that on substituting gallic acid for the astringent, the redness of the urine had gradually disappeared, and its coagulability had diminished.

'On October 17th, Dr. Christison saw him again; he was still not strong, but without his former haggard look, and decidedly regaining flesh. There had been no return of hæmaturia, but the urine was still somewhat coagulable. Circumstances having rendered it convenient for him to winter at the Cape of Good Hope, Dr. Christison advised him to resort thither; and the gallic acid was continued. He returned to this country in October, 1846, and wrote to Dr. Christison thus: 'As soon as I got into warm weather, and out of the turmoil of professional business, I began to improve in health and strength, gathered flesh, got colour, and ere arriving at the Cape, was stouter than I had been for years. After using the gallic acid for a few days at sea, I had no appearance of albuminuria, nor has there been any return of it since. I travelled about 1500 miles on horseback, through the Cape colony, and had several long journeys, one of them to the extent of eighty-eight miles in one day, without suffering any ill consequences.'

'On returning to this country he resumed his practice, and he continues at this time (March 1851, six years after his illness), an active, vigorous, healthy, country practitioner.'

There were evident signs of amendment in this case before the patient went to sea; and it would be difficult to determine how much of the subsequent improvement was due to the sea air and change of climate, and how much to the escape from 'the turmoil of professional business.' In some respects, therefore, the following case is a still more striking and unequivocal illustration of the beneficial influence of a sea voyage.

Sarah Lynch, æt. 30, the wife of a soldier, came into King's College Hospital, on the 28th of October, 1847. She was suffering from general dropsy in an extreme degree; and she gave the following history of herself. She had been in many and distant parts of the world, and her health was always better in cold or temperate climates than in hot ones, the latter having the effect of making her languid. In Canada, where she lived for some time, her health was very good. At the commencement of the year 1845 she went to Ceylon, and after being there about half a year, she was seized with symptoms of dropsy, which came on in the month of September. The urine was scanty and high coloured; the dropsy continued to increase, affecting the whole body, which was very much swollen. Her legs were scarified, and discharged copiously. She gradually grew worse, until the month of August in the following year, when her husband's regiment having been ordered home, she embarked for England, being at the time very ill and dropsical. The vessel in which she sailed had no surgeon on board; she consequently took no medicine whatever. After she had recovered from the sea-sickness, she found that her health was improving; when they reached the Cape the dropsy was sensibly less, the improvement continued, and when she arrived in England, after a voyage of four months and a half, the dropsy had entirely disappeared, and she felt perfectly well.

She continued in the enjoyment of good health, working as a washerwoman, until the beginning of the month of October, 1847, when she was seized with pain in the stomach and loins, followed by general dropsy, occasioned, as she believed, by exposure to cold, after being heated at her work.

At the time of her admission, on the 28th of October, there was great swelling of the legs and abdomen, and puffiness of the face, severe pain in the loins, increased by pressure; the urine was scanty, high coloured, and very albuminous: it was not at that time examined microscopically. Subsequently the urine became pale, increased in quantity—varying from three to seven pints in twenty-four hours, of low specific gravity—from 1007 to 1015, and still highly albuminous. The dropsy continued and increased. In the month of February I examined the urine several times, and found indications of an advanced stage of renal degeneration, there being scarcely a trace of the granular casts, but considerable numbers of the 'large waxy casts,' showing that the tubes had lost their epithelial lining, and were becoming filled with this unorganized material. (See p. 184.) The case was now evidently hopeless. The poor woman left the hospital on the

30th of January, 1848, and died at her own home in Rochester, about the beginning of the following April. I learnt that the immediate cause of death was erysipelas of the legs supervening upon scarification. No examination of the body was made after death.

The narrative of this case well serves the purpose for which I have introduced it—viz., that of showing the great and extraordinary benefit which the subjects of renal disease may sometimes derive from a sea voyage, and that, too, under circumstances apparently the most unfavourable. During the eleven months previous to this poor woman's departure from Ceylon, she had grown gradually worse, and during the voyage home she progressively improved, until she appeared to be quite well. It may perhaps admit of a doubt whether the recovery was as complete as she believed, and whether at any time after the first attack of dropsy the urine had ceased to be albuminous. The length of time during which the disease had existed is against the probability of its entire removal; but, on the other hand, the apparently good health of the woman, and her ability to do the toilsome work of washing, are evidence in favour of a complete recovery; and this is confirmed by the character of the urine at the commencement of the last attack, which being scanty, high coloured, and probably bloody, appeared to indicate the absence of any pre-existing chronic disease. (See p. 187.) The doubt upon this point scarcely lessens the evidence which the history of the case affords as to the beneficial influence of a sea voyage.

It is, of course, the duty of a physician to exercise sound judgment and caution before advising such a means of cure, ascertaining by the history of the disease and the condition of the urine the probable nature, extent, and stage of the renal degeneration, and taking care not to expose his patient to the discomforts and perils of a sea voyage without some reasonable hope of decided relief and benefit.

When a sea voyage appears undesirable or impracticable, a temporary residence on the sea coast, or at some inland watering-place, may be beneficial, the place being selected according to the nature of the season and the character of the symptoms. The residence in winter should be warm and sheltered, so as to admit of exercise being taken in the open air. In summer a more exposed situation may be chosen, one which will exert a bracing and tonic influence; but it must not be forgotten that a patient with renal disease can never, without great risk, be exposed to a chilling wind. I once went into the country to see a clergyman who was dying with suppression of urine. He had for some time been suffering from chronic renal disease, with albuminous urine, the result, as appeared, of over work at his pastoral duties in London; he had no dropsy, but his health and strength were much impaired and reduced. He was advised to leave town for rest and change of air, and shortly after doing so he sat one day in the open air; it was in the month of July, but a cold wind was blowing. Within a few hours he became seriously worse; the urine was extremely scanty, almost suppressed. He became prostrate, with profuse cold perspirations, and died in about a week from the time of the seizure, retaining his consciousness to the last. From an examination of a small quantity of urine which was drawn from the bladder, I concluded that there was fatty degeneration of the kidney. It is probable, therefore, that, under any circumstances, the disease would have been incurable, but the fatal termination was, perhaps, much hastened by the imprudent exposure.

When catarrhal symptoms are present, or when there is any tendency to internal congestion or inflammation, there is the more obvious necessity for caution with regard to exposure. The presence of dropsy, too, is an additional reason for vigilance and care.

In the treatment of chronic renal disease amongst the poor of large towns, a temporary stay in a country infirmary or convalescent institution, either by the sea-side or inland, is an important means of cure, which should not be omitted when it is attainable. The same means will be found of great value when there appears a tendency to chronic degeneration after an attack of acute renal disease.

The skin, as already suggested, should be kept warm by a moderate amount of clothing, and its action may be further promoted by an occasional use of the warm bath in the form of water, air, or vapour, in addition to which some diaphoretic medicines may be administered when a more decided action of the skin appears desirable. The citrate of ammonia is a mild, but frequently an efficient diaphoretic, and given in an effervescing form, it is not an unpleasant medicine. The preparations of antimony are of great value, more especially when there is heat of skin, with other feverish symptoms, or when there is a tendency to congestion or inflammation of the lungs.

The bowels are to be carefully regulated by occasional moderate doses of purgative medicine; but active purging is not desirable, except as a means of removing some of the secondary consequences of the renal disease. In those cases which are connected with gout, it may be useful to give aperient medicine, in combination with small doses of the wine or the acetous extract of colchicum. From half a grain to a grain of the last-mentioned preparation, may be given with from three to five grains of the compound colocynth pill every night, or on alternate nights, so as to keep up a moderate action of the bowels; or ten drops of the wine of colchicum may be given once or twice daily in a mixture, with the sulphate and carbonate of magnesia; this combination is particularly useful when the urine is acid, and deposits the urates.

In the earlier stages of chronic renal disease, if there is much pain in the loins, the urine being at the same time scanty, deeply coloured, and highly albuminous, the abstraction of a small quantity of blood by cupping over the kidneys may be of service. But I have seldom seen such an amount of benefit from this measure in cases of chronic disease as would justify its employment, without a very urgent call for it. The more advanced the disease, the less is the probability of any benefit resulting from local bleeding, and the less is the patient able to bear the loss of even the smallest quantity of blood. In these circumstances dry cupping sometimes affords considerable relief. It may be frequently repeated—daily, or even twice in the day; its revulsive influence is very great and beneficial, and it is, perhaps, the most efficient counter-irritant that can be employed in such cases. In addition to this means, or as a substitute for it, the skin of the loins may sometimes be kept in a state of irritation by ammonia, mustard, or tartar-emetic. Ordinary blisters should be avoided on account of the tendency which the cantharides have to irritate the kidneys. For the same reason, there is danger in the use of turpentine, either applied to the skin as a counter-irritant or in the form of enema. It must be remembered that an amount of irritation from either of these agents, which, when the kidneys are healthy, would be only a slight temporary inconvenience, might prove a source of fatal mischief with the kidneys in an advanced stage of structural degeneration.

The application of an issue or a seton to the loins is sometimes recommended; but it is, perhaps, doubtful whether the exhausting influence of the continual drain might not be injurious rather than otherwise. When such a means of cure is resorted to, its effect must be carefully watched, so that it may be continued or not, as the circumstances appear to require.

The use of some of the preparations of iron, which I have recommended during the convalescence from acute nephritis, is equally important as a remedy in cases of chronic renal disease. Iron is a medicine which is plainly indicated by the pallor of the skin and the other appearances of anæmia; and experience has abundantly proved the value of the remedy. It is not to be supposed that the use of steel will be as efficacious in restoring the colouring matter of the blood in cases of renal disease, as when it is given for the cure of chlorosis; since, in the latter condition, there appears to be a simple deficiency of some of the constituents of the blood, whereas, in the case of renal disease, this defective composition of the blood is associated with, and is partly a consequence of, the retention of poisonous excrement. It is therefore important, while administering the iron, for the purpose of restoring the normal constituents of the blood, not to neglect any available means of freeing the blood from its accumulated excrement.

While the patient is taking iron it is desirable that the bowels should be kept regularly but moderately open; and the functions of the skin may sometimes be promoted by combining the citrate of iron with the citrate of ammonia. I believe, however, that the tincture of the sesquichloride is one of the most valuable preparations of iron. The free acid which it contains appears often to exert a beneficial influence upon the stomach, giving tone to the organ and relieving the dyspeptic symptoms which are amongst the most troublesome accompaniments of renal disease; the medicine, when absorbed, tends to restore to the blood its colouring matter, and, in passing through the kidneys, it appears to exert an astringent influence and to check the drain of albumen. Its last-mentioned astringent effect renders it inapplicable when there is great congestion of the kidney, with a scanty secretion of urine. It may be given, as before recommended (p. 136), in infusion of calumba, or occasionally in combination with tincture of digitalis. It may sometimes be desirable to give iron in larger doses than could be administered in the form of the tincture; this may be done by giving the sulphate in doses of two grains, made into two pills, with extract of gentian, and a grain or two of powdered ginger—a dose which may be given, after a meal, two or three times daily.

The remarks which I have before made on the use of mercurial and diuretic medicines are, with one or two exceptions, as applicable to the treatment of chronic as of acute renal disease. Mercury is occasionally admissible as an aperient in combination with other purgative medicines; it should never be given without good reason, and always with care and watchfulness, on account of the readiness with which the subjects of renal disease are often salivated. There is yet one other purpose for which mercury may be given, and that is, to promote the action of diuretics in the only circumstances in which the administration of this class of remedies is admissible—viz., to remove a dropsical effusion when it is excessive, and after other medicines have failed to give relief. I shall revert to this subject in describing the treatment of dropsy.

The preceding remarks on the treatment of chronic renal disease have had reference chiefly to the primary disease of the kidney itself; and the complete removal of this would probably, in most cases, be followed by the disappearance of its secondary consequences. Some of these secondary consequences, however, constitute in themselves very serious diseases, and as such they require special consideration, not only as regards the prognosis, but also with reference to treatment.

Dropsical effusion is one of the most frequent and most distressing of the secondary consequences of renal disease, and it is one the treatment of which requires much care and judgment. A consideration of the pathology of renal dropsy, will show that the complete and permanent removal of this symptom can generally be effected only by restoring the kidney to its normal condition, so that the blood may be freed from those retained impurities which cause the dropsical effusion. All those means, therefore, which tend to remove the morbid condition of the kidney, are indirectly efficient for the cure of the dropsy consequent upon the renal disease, and in cases of acute disease of the kidney it is seldom necessary that remedies should be given for the immediate purpose of removing the dropsy. But in a large proportion of cases of chronic renal disease, when the secreting tissues of the kidney are so far degenerated that we cannot hope to restore them to a healthy condition, and when, consequently, the blood must continue to be poisoned, in a greater or less degree, with renal excrement, the dropsy which is consequent upon that condition of the kidneys and of the blood, constitutes so prominent, and often so painful, a symptom, that there is an urgent call for the adoption of some means which tend directly to the removal of the effused liquid.

The purgative method of removing dropsical effusion is that which is, perhaps, the most efficient, and, at the same time, attended with fewer risks and disadvantages. Those purgatives must be selected which produce copious watery stools. Elaterium, gamboge, and jalap, either with or without the addition of a saline, are the medicines which experience proves to be most useful.

The elaterium may be given in doses of from one-eighth to one-fourth of a grain, made into a pill, with some aromatic. It sometimes causes sickness and griping; but frequently it acts without these unpleasant consequences, and, in any cases where it produces a copious discharge of water, its action is followed by great relief from dyspnœa and other distressing symptoms. It often happens that a dropsical patient, apparently moribund from exhaustion, is restored, as it were, to a new life by the free action of elaterium. The relief afforded does not depend merely on the discharge of liquid, but, in part, upon the elimination of the poisonous excrement which passes off with the liquid. Dr. Golding Bird* has detected urea abundantly in the copious evacuations from the intestines, produced by the action of elaterium. The medicine must be repeated with greater or less frequency, according to the effect produced, and the character

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* *Urinary Deposits,* third edition, p. 71.

and urgency of the symptoms. The practitioner should bear in mind that the action of elaterium is uncertain, on account of the adulterations to which it is often subjected by those who prepare or sell it. He may learn from Dr. Pereira* what are the characters of the genuine drug, as well as the means of detecting its adulteration. He will do well to avoid those druggists who supply him with a spurious article, and he should be careful, in prescribing the medicine, not to give a large dose until he has tested its activity; for, although a compound of elaterium, with chalk and starch, may be nearly inert, the genuine elaterium is a very active medicine, of which a quarter of a grain is, as Dr. Pereira says, a full dose.

Dr. Christison has employed gamboge more frequently than any other purgative, and generally in doses of five grains, sometimes seven, very rarely nine. In order to prevent griping, it is important to secure its being very finely divided, by triturating it with half a drachm of bitartrate of potash, and to this may be added some powdered ginger. This medicine may be repeated every two or three days, or oftener, according to its degree of operation and the urgency of the symptoms.

The compound jalap powder of the *London Pharmacopœia* is another medicine which is very often efficacious in removing a dropsical effusion by exciting watery evacuations from the intestines. It may be given in doses of from one to two scruples, and it is

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* *Materia Medica.*

generally milder in its action than either elaterium or gamboge.

While the patient is taking these medicines, the operation of which frequently has a depressing influence, his strength must be supported by such nourishing food as he is able to digest; and occasionally it may be necessary to administer some stimulant, such as the aromatic spirit of ammonia, or a small quantity of brandy diluted with water. Great benefit, too, may often be derived from the continued exhibition of iron, which tends to increase the solid constituents of the blood, while the purgatives diminish the water. Thus the conjoint action of the iron and the purgatives, tends to remove two of the conditions which have been before alluded to, as favouring the occurrence of dropsy.

The use of purgatives is sometimes forbidden by a spontaneous diarrhœa, which has already been alluded to amongst the other secondary consequences of renal disease. It is probably the result of an effort to eliminate some of the noxious materials with which the blood is charged, and it is doubtful whether it can with perfect safety be suddenly or completely checked.

In such circumstances, and indeed in almost any case of renal dropsy, much benefit is sometimes derived from measures that tend to increase the cutaneous transpiration. The hot-air bath is one of the most efficient means of attaining this object; and by its aid a large quantity of water may be thrown off through the skin, with the effect of affording at least temporary relief to the patient. In pursuance of the same indication, diaphoretic medicines may at the same time be perseveringly given, care being taken that their action is not hindered by exposure to cold.

As to the treatment of renal dropsy by diuretics, I believe that it should seldom be resorted to, and there are very obvious reasons why it can rarely be successful. Some of these I have already alluded to (p. 137); but there are some conditions which are peculiar to chronic nephritis. One is, that in these cases a great degree of dropsy often co-exists with a copious discharge of watery urine by the kidneys, the dropsy resulting, as we suppose, from the contamination of the blood by renal excrement, which, being a powerful natural diuretic, would effect its own discharge if the secreting structures of the kidney were not in great part disorganized. To speak of the kidneys, in this condition, as being torpid, is a metaphor based upon an indistinct perception of facts; and the notion of a stimulus being required is as unreasonable as to apply whip or spurs to a horse whose locomotive powers are impaired by the loss of one of his limbs.

Professor Krähmer* has shown, as the result of a large number of observations, that diuretics do not increase the amount of solids discharged by the kidneys, even when these organs are healthy. How small, then, is the probability that the exhibition of diuretics should promote the discharge of the solid constituents of the urine when the kidneys are

* *British and Foreign Med.-Chir. Review,* July, 1848, p. 250.

diseased? It is true, that if by any means the kidney can be made to throw off an increased quantity of liquid, this will bring relief from some of the distressing effects of a dropsical accumulation. But even this result of administering diuretics is acknowledged to be most uncertain, and often quite unattainable, while there is considerable risk that the medicines will, by their irritant action, accelerate the progress of the disease in the kidney.

In these painful and perplexing circumstances, when the urine is scanty, and when other measures have failed, as they often will, to remove the dropsy; when diarrhœa forbids the use of purgatives, or when purgatives and diaphoretics together have proved insufficient, 'we *must*,' as Dr. Watson teaches, 'choose the least of two evils; or rather, we must incur the risk of one possible and contingent evil for the chance of obtaining what, if obtained, is a certain and positive benefit; we must endeavour to remove the dropsical accumulation by means of *diuretics*, whether these accelerate the progress of the disease in the kidney or not.' Such diuretics, therefore, are to be selected as seem least likely to stimulate the kidneys injuriously; and the preference appears to be due to those originally recommended by Dr. Bright—namely, digitalis and cream of tartar. The action of these medicines appears to be more certain when given simultaneously than when separately exhibited. The digitalis may be given in doses of ten or fifteen minims of the tincture three times daily, in an ounce of cinnamon water, or the infusion of the same substance in doses of from two to six drachms with cinnamon-water. The cream of tartar may be given thrice daily in doses of from one to two drachms in five or six ounces of water, so as to ensure its absorption; with a smaller quantity of water, and sometimes even without the condition of concentration, the cream of tartar acts as a hydragogue purgative, to which, however, there is no objection, unless when there is a tendency to obstinate diarrhœa. In prescribing all diuretic medicines it is important to remember and to act upon the principle, that their absorption and their consequent action upon the kidneys are favoured by their being administered in a sufficiently diluted condition.*

Diuresis occasionally appears to be promoted by the exhibition of mild doses of mercury, and for this purpose it may be permitted to give a pill containing a grain or two of calomel, or three or four grains of blue pill, sometimes with a grain of powdered squill, the diuretic action of which is thought to be much increased by its being combined with mercury. This dose may be repeated for three or four successive nights, unless in a shorter time it has had the desired effect of increasing the flow of urine, or except when the gums are more speedily affected by the medicine. When diuresis is once established, it may often, as Dr. Christison observes, be maintained almost indefinitely by digitalis alone, in the dose of ten or fifteen minims

* Some interesting and valuable remarks upon this subject will be found in the concluding chapter of Dr. Golding Bird's treatise *On Urinary Deposits.*

of the tincture daily. Sometimes, too, when it has been artificially produced, it will go on naturally for a long period, until the dropsical effusion has been entirely removed, or even still longer. This is a fact which has its analogy in many morbid phenomena, and particularly in instances of what is commonly understood by metastasis. Thus, as we have seen, when the poison of scarlatina has been driven from the skin to the kidneys, it cannot ordinarily be brought back again by any solicitation; but having commenced its exit by the kidneys, thither it continues to go, and thence it passes, until the blood has become entirely freed from it. These phenomena appear to result from what, perhaps, we may be permitted to call a vital *vis inertiæ*, so that when the vital actions have taken a particular direction, they cannot be arrested or diverted from their course without some adequate disturbing cause. In the application of revulsive and counter-irritant remedies, we endeavour, and often successfully, to divert the course of morbid action.

It has sometimes been found that the external application of diuretics has excited a copious discharge of urine, and has thus removed dropsical effusion after the internal administration of the same remedies has been unsuccessful. This plan of treatment has recently been tried in Edinburgh, and is recommended by Dr. Robert Christison,* who uses a strong infusion of digitalis, made by adding an ounce of the powdered

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* *Edinburgh Monthly Journal,* October, 1850, p. 310.

leaves to twenty ounces of boiling water. A large piece of spongio-piline steeped in this infusion is to be kept constantly upon the abdomen. Dr. Christison says, 'I have used this method both in simple ascites, and likewise when that affection formed a prominent part of a more general dropsy. The issue has of course been variable, and more frequently unfavourable than successful. But, on the whole, the results of my own observation, and the experience of others in Edinburgh, who have also tried this practice, lead to the conclusion that digitalis not unfrequently succeeds in this way when not only it, but likewise all other diuretics taken internally, as well as the purgative method of cure, prove of no avail. It has likewise been tried with success in a few cases of obstinate excessive œdema of the limbs, in connexion with general anasarca and Bright's disease of the kidneys, after diaphoretics, purgatives, and diuretics internally, had failed to give relief.' The plan thus recommended by Dr. Christison is well deserving of a careful trial. My own experience of it has as yet been so limited, that I can offer no opinion as to its advantages.

When all other means have failed to remove the dropsy, it is sometimes necessary to resort to mechanical expedients for getting rid of the liquid, and for averting the painful and dangerous consequences of its excessive accumulation.

The areolar tissue and the skin of the legs are the parts which, more frequently than any others, suffer from over-distension. The skin becomes very tense, and erythematous, then frequently vesicates, and discharges serum abundantly, affording great relief from pain, and sometimes entirely removing the dropsy. Occasionally the cellular tissue sloughs extensively and deeply, so as to endanger or even destroy life. This spontaneous mode of draining away the liquid may be imitated by making a few punctures in the tense integuments with a needle. It appears that there is a greater probability of erysipelas supervening upon the discharge of the serum, in cases of renal disease, than when the dropsy is of cardiac origin, because in the former class of cases the serum has more or less of the irritant properties of urine, with some of the constituents of which it is charged. But in any case it is difficult to believe that the risk of ill consequences is greater when the serum is discharged by acupuncture than when it escapes spontaneously through the ulcerated integuments. It is probable that in some of these cases, when inflammation follows the puncturing, the same event would have occurred, even although no punctures had been made, as a consequence of over-distension of the integuments; and I believe that inflammation of the skin is much more frequently removed than induced by acupuncture. The punctures should not be too near each other; Dr. Watson says, not less than an inch and a half distant. Neither should they be too deep, nor too numerous. If they pass fairly through the skin into the subcutaneous tissues, that is sufficent; and half-a-dozen punctures will give speedy exit to an abundant flow of liquid.

It may sometimes be necessary to remove some liquid from the peritoneum by means of a trocar, but it is an operation which should be avoided if possible. The circumstances which call for it are—first, pain from over-distension, vomiting, or other ill consequences of pressure on the stomach and bowels; and, secondly, urgent dyspnœa, or palpitation, the result of an impediment to the action of the lungs and heart. Since the speedy reaccumulation of the liquid is an exhausting drain upon the system, it is better to draw off only so much as will suffice to remove the more distressing consequences of its pressure, repeating the operation if necessary.

It frequently happens, that immediately after the liquid has been permitted to escape, by tapping the abdomen, or by puncturing the legs, the kidneys begin to secrete more copiously. The great tension of the parts, and the mechanical pressure upon the vessels, having been removed, the circulation is less impeded, and secretion consequently becomes more abundant.

The *dyspeptic symptoms* which are commonly associated with renal disease, will be best relieved by that general system of management as to diet, which has been recommended for the primary disease. When there is much acidity, with pain and vomiting, relief is often afforded by small doses of the carbonate of magnesia, or of the bicarbonates of soda or potash, taken once or twice daily. When the sickness is obstinate and distressing, frequent small doses of hydrocyanic acid may be given, or, what is sometimes successful when this fails, a drop of creasote in mucilage three or four times daily. Counter-irritation over the stomach is sometimes beneficial. But the main point, in the management of these derangements, is strict attention to the quantity and quality of the food, remembering always, that when an organ is weak and diseased, its ordinary work must be diminished and facilitated as much as possible.

Diarrhœa, like the gastric derangements, may often be checked by strict attention to diet. An occasional dose of castor oil is useful, by removing undigested food or other irritating matters. When the discharges are moderate, and unaccompanied with pain, it may admit of a doubt whether they should be suddenly and completely checked; for, as we have seen, they are a means of purging away poisonous excrement which, perhaps, could not otherwise, or so conveniently, be eliminated. When the diarrhœa is profuse and exhausting, it must be checked by astringents, which may sometimes be combined with opiates. It is important, however, to exercise great caution in the use of opium in the advanced stages of renal disease, and especially when there appears any tendency to drowsiness; for in no circumstances is an opiate so likely to produce dangerous and unmanageable stupor, as when its influence is added to that of urea in the blood.

The *Pulmonary complications*, which are of extreme frequency, and often very obstinate and distressing, scarcely require special directions as to their treatment. Bearing in mind the enfeebled condition of the body in which they occur, we shall avoid all active depleting measures, trusting chiefly to counter-irritation, and small local bleedings when necessary, with the internal administration of moderate doses of antimony or ipecacuanha, in combination with salines. Sometimes a more stimulating treatment will be of service; small doses, frequently repeated, of the sesquicarbonate, or the aromatic spirit of ammonia in camphor mixture, and combined occasionally with the tincture of squill; or, when the cough is troublesome, with the compound tincture of camphor, in doses of twenty minims or half a drachm.

It is scarcely necessary to add, that when there is a tendency to pulmonary congestion and to catarrh, the patient must be protected from cold and from the vicissitudes of the weather.

As to the treatment of the *inflammations of the serous membranes* I need add nothing to the few suggestions which I have before made upon the subject (p. 133), except that, if mercury and active depletion are injurious in the treatment of those inflammations which result from recent and acute disease of the kidney, they are still more so when the renal disease has been of long standing, and when the powers of the system have been proportionably reduced.

Chronic Rheumatism is one of the secondary consequences of renal disease, which is more likely to be removed by the judicious treatment of the primary malady, than by the administration of any remedies which are supposed to have a specific efficacy in the cure of rheumatism.

The warm water, or the hot-air bath will often relieve the pains, and this may be assisted by stimulating or anodyne liniments, and by an occasional opiate at night when there is nothing to contra-indicate the use of opium.

Cerebral disorders.—Amongst the most formidable of the secondary diseases are those which have their seat in the nervous centres, and which manifest themselves by the occurrence of headache, delirium, drowsiness, coma, or convulsions—one or more of these symptoms appearing in conjunction or in succession. I need say little here upon the treatment of these symptoms, as I have already discussed this subject fully in a former chapter (p. 131). The treatment which they require is the same, whether they occur as a consequence of acute or of chronic disease in the kidney, but the probability of a successful result is much less in the latter case than in the former, since in the case of chronic renal disease, the occurrence of alarming cerebral symptoms is commonly associated with very extensive degeneration of the secreting tissues of the kidney. While, therefore, the treatment is essentially the same in the two classes of cases, the prognosis must be very different; and no opinion can be given as to the result of treatment in a case where cerebral symptoms are associated with disease of the kidney, until the nature and the extent of the renal degeneration have been ascertained from a careful examination of the urine.

The remedies which are most likely to be beneficial are, cupping, to a small amount, over the loins, free purging with elaterium or with colocynth, sometimes combined with calomel, and followed by a black draught, and occasionally, perhaps, the abstraction of a small quantity of blood from the temples by leeches or cupping. It will be well to remember Dr. Watson's suggestion, before quoted (p. 201), that the stupor and coma may sometimes be dependent on the watery condition of the blood, and to be very cautious in abstracting blood, when pallor of the skin, and other appearances, indicate a defect of hæmatosin. The high authority of Dr. Todd, too, may be quoted in confirmation of the opinion that an impoverished condition of the blood favours the poisonous action of urea.* Cold lotions may be applied to the shaved head when the scalp is hot, and blisters when the skin is cool.

It will too often happen that all these measures will fail to relieve the cerebral symptoms, for the reason before alluded to, that scarcely any of the secreting tissues of the kidney remain, and that, consequently, the blood is charged with poisonous excrement which our remedies have little power to eliminate, and less to prevent, from exerting its poisonous influence upon the brain. Frerichs† recommends the administration of chlorine or the vegetable acids, with the view of their entering the blood and forming innocuous compounds with ammonia; the carbonate of ammonia which results from the decomposition of urea being, as he thinks, the poisonous agent which causes the coma and convulsions. (See *ante*, p. 202.) He expects particular benefit from large doses of benzoic acid, and

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* *Lumleian Lectures on Delirium and Coma. Med. Gaz.* 1850.

† *Op. cit.* p 230.

he advises the use of vinegar lotions and enemata, but he appears to have had little opportunity of trying his proposed plan of treatment.

Since, in any case, it is an easier and a more hopeful task to prevent drowsiness from passing into coma, than to bring a patient out of a comatose condition when once he has fallen into it, it is important to keep a watchful eye upon the premonitory symptoms, and to meet them by the prompt application of remedies.

Valvular disease of the Heart occurring in connexion with renal disease, is a serious complication, for the removal of which scarcely anything can be done. The best means of preventing the increase of the disease will be such as tend to free the blood from those impurities which have originally excited it. These have already been referred to in connexion with the treatment of the renal disease.

A recent attack of pericarditis would require moderate local bleeding and counter-irritation, like the inflammation of other serous membranes.

Hypertrophy of the muscular substance, whether it occur as a consequence of valvular disease, or without that complication, is, as we have seen, a beneficial and compensative process, intended to overcome some impediment in the course of the circulation. This wholesome growth of the heart's walls is to be assisted by a due supply of nutritious food, and occasionally by the administration of tonics, amongst which the preparations of iron are often of great service, since by adding to the normal constituents of the blood, they not only supply the heart with better nourishment, but they bring the blood into a condition which admits of its passing more freely through the capillary vessels, (see p. 253); so that the power of the heart is increased, while its work is lessened.

Cirrhosis of the Liver, which is a frequent complication of renal disease in the case of those who have been intemperate, is as difficult of cure as the disease of the kidney itself. The same general plan of treatment required by the renal disease, will be beneficial for the hepatic affection; and, in addition, when there is much pain or a sense of fulness over the liver, a small local bleeding or a blister may be of service. The complication of hepatic disease will increase the tendency to ascites, and it is in such cases that the operation of tapping the abdomen may become necessary. I have already mentioned the circumstances which may call for this proceeding, and the precautions which should be exercised (p. 288).

In conclusion, I would suggest the importance of remembering that the various secondary diseases to which allusion has been made, have a common origin, and that although, in attempting to cure or alleviate them, it is sometimes necessary to apply remedies to each singly, yet this should never be done in forgetfulness of the bond of union which exists between the secondary diseases themselves, as well as between them and the primary disease. Without this guiding pathological principle, we might, more frequently than is necessary, aggravate one disease in our endeavour to remove another, or fail to relieve a particular disorder by treating it as a merely local mischief, when a better pathology would have indicated a distant part as the source of the evil, and the point to which the remedies should be directed. A good illustration of this principle is afforded in the instance of convulsions and coma being relieved by treatment applied chiefly to the kidneys. (See p. 131.)

Appendix to Chapter IV.

1. *Illustrative Cases.* — 2. *Additional Observations on Renal Cysts.*—3. *Development of New Fibrous Tissue in the Kidney.*

Case XI.

Numerous attacks of gout; chronic desquamative nephritis; urine albuminous, waxy casts, almost complete suppression.—Kidney wasted; urinary tubes denuded; arteries and Malpighian capillaries thickened.

Thomas Hewson, æt. 49, was brought up as an engraver, then became a porter, and subsequently a gentleman's coachman. Has always drunk freely of porter, on an average half a gallon daily. At the age of twenty-five he had inflammation of the chest, and during this attack he was first seized with gout in one great toe. About three or four years after, he had a second attack of gout, and two years after this a third, in each case confined to one great toe; the fourth attack affected both feet after an interval of one year. From this time the attacks of gout came on more frequently, and affected, at different times, almost every joint; for several years before his death he was disabled for about nine months in each year; his diet has consequently been rather poor. I attended him frequently as a dispensary patient before I had any suspicion of renal disease.

On the 7th of June, 1849, the urine had a specific gravity 1015; it was pale, and deposited a very slight cloud, containing a few white, well-defined, waxy casts (see p. 185), of large size, some of them entangling minute, round cells, scarcely a particle of renal epithelium; it contained a large quantity of albumen, becoming almost solid when boiled. He is of rather small stature, hair and whiskers sandy, face pallid, considerable emaciation. During the last two years the legs have occasionally become œdematous after sitting up, and the face has sometimes been slightly swollen; but there is now no appearance of dropsy. A short time since he had an attack of gout, but he now complains chiefly of weakness, which confines him to his bed. The joints are free from deposits and distortions, except a slight contraction of the fingers of the right hand. The sounds of the heart are normal. His wife observed, that during the earlier attacks of gout the urine has generally been high-coloured and turbid, but that latterly it has remained pale and free from deposit even when the joints are acutely inflamed.

To take small doses of tinct. ferri sesquichlor.

The urine examined on the 18th and 27th of June, with the same result as before.

July 3rd.—During the last fortnight he has become deaf; he is much changed in appearance; he sometimes appears confused in his intellect; the limbs frequently move in a chorea-like manner; he is very pale and thin; complains of an acrid taste in his mouth; breath fœtid; occasional bleeding at the nose; frequent vomiting, urine scanty, the quantity obtained being insufficient for ascertaining its specific gravity, highly albuminous; a rather copious, dense deposit of a whitish-brown colour, composed of numerous casts, varying in diameter from $\frac{1}{375}$ to $\frac{1}{750}$ of an inch. Most of them are smooth, white, and homogeneous, or contain, here and there, a small nucleus or cell; but some are granular and nearly black, apparently composed of the same material as the others, but in a disintegrated state; some of the same white waxy material in irregular granular masses scattered about the field; no epithelium, either entire or disintegrated.

Haustus effervesc. 4tis h.

July 7th.—Is worse; frequent vomiting of a dark-green fœtid material; severe headache; discharge from the ears; is very deaf; face pallid; takes no nourishment; has passed about two ounces of urine during the last twenty-four hours; this is pale, very albuminous; a very slight sediment, containing traces of the same casts as before. No dropsy.

Rep. haust. efferv. Ext. elaterii, gr. $\frac{1}{4}$ in pil. statim.

July 11th.—Much the same; frequent vomiting of the same fœtid material; urine about four or six ounces in twenty-four hours; yesterday its specific gravity was 1016, to-day 1019, pale, highly albuminous; a very scanty sediment, with traces of the same casts as before; to-day, during an examination of ten minutes, I detected only one cast.

July 14th.—Much the same, but more exhausted, very pallid, skin cool. He became suddenly faint, and died soon after my visit, retaining his consciousness and power of speech until within a few minutes of his death.

Inspection, on the fourth day after death. The weather being warm, and putrefaction having commenced, the kidneys were removed by an opening in the abdomen, and no other parts were examined. Both kidneys had much the same appearance. Their size rather less than normal, one weighed three and a half ounces, surface smooth; in the cortical substance of one there was a cyst about the size of a horse-bean; they were slate-coloured from incipient decomposition; the chief structural change visible to the naked eye consisted in the absence of the usual lobular appearance on the surface (see pp. 9 to 11); the cortical substance was rather thin. An unpractised observer might have pronounced them healthy.

On a microscopic examination the Malpighian bodies appeared very conspicuous, while the tubular structure was confused and indistinct. After the addition of acetic acid the tubes became much more distinct, many were denuded and atrophied, scarcely one could be seen with the normal epithelial lining; some contained oil, others brown granular particles of disintegrated epithelium, and a very few contained the white waxy material which had formed the casts observed in the urine during life.

In consequence of the atrophy of the tubes, the Malpighian bodies seemed relatively more numerous and closer together than ordinary; they were not perceptibly enlarged; one of the largest measured $\frac{1}{75}$ of an inch. The Malpighian tufts were of a dull-white colour, the surface of the vessels smooth, their coats thickened, their canals clearly visible in many instances, especially after adding acetic acid, which also brought into view the blood-corpuscles in their interior. The muscular coats of the arteries were hypertrophied, and the canal of one contained some small masses of oil.

Remarks.—This case affords a good example of the extent to which disease may proceed without the occurrence of any urgent symptom. The pallor of the countenance, the occasional slight œdema, and the repeated attacks of gout, led to the examination of the urine, and then the nature and the extent of the renal disease were apparent. The light-coloured highly albuminous urine, with a scanty sediment, chiefly composed of large waxy casts, with a very few granular casts, showed the probability that the tubes had become pretty generally denuded by the chronic desquamative process, and serious symptoms appeared very quickly after this observation had been made. With reference to these it may be observed, that his long confinement to the house by the gouty attacks, and the consequent protection from cold, had probably prevented the earlier occurrence of urgent symptoms, and that when the urine at length became almost suppressed, he would probably have suffered from convulsions or coma but for the vicarious action of the gastro-intestinal mucous membrane. I regret that the fœtid liquid which he vomited was not examined chemically, but there can be little doubt that it was urinous. He remained sensible to the last, and died from exhaustion. The bleeding at the nose, from which he occasionally suffered, is a symptom which I have repeatedly observed in cases of renal disease (see Revels, No. 15), and which I have supposed to depend upon the altered condition of blood induced by the disease.

Case XII.

Intemperance; dropsy; albuminous urine, large waxy casts. — Contracted granular kidneys; denuded tubes, thickening of the arteries and Malpighian capillaries.

Eliza Brooks, æt. 37.—The history of this patient is in some respects imperfect. My first note of her is dated June 1, 1849. I was then attending her as a dispensary patient. Her habits have been very intemperate; latterly she has lived badly; she has suffered from menorrhagia and leucorrhœa; considerable dropsy of the legs and abdomen; this is of recent occurrence, and has come on gradually. Urine pale, sp. gr. 1010; albumen rather abundant, when coagulated occupying one-sixth of the test tube. A white sediment, mostly composed of clustered and scattered pavement epithelium, probably from the bladder. During a careful examination a very few waxy casts of large size were observed.

June 2nd.—Urine again examined, with the same result, except that the waxy casts were more numerous.

She went into King's College Hospital on the 6th June, and I did not examine the urine again until June 26th. It was then very ammoniacal, with an abundant deposit of triple phosphate, a phosphatic film on the surface, and the whole liquid white and turbid; albumen abundant. Amongst the numerous crystals of the phosphatic salts it was impossible to detect any renal casts.

From this time the urine continually had the same characters —it was highly ammoniacal, effervesced briskly, and formed a copious coagulum on the addition of nitric acid. The deposit of the triple phosphate was so abundant as to render any examination for renal casts very unsatisfactory. Occasionally, however, portions of the above-mentioned waxy material were observed. On the 20th of July the sp. gr. of the urine was 1015.

In the meantime all the symptoms became worse; the dropsy of the legs and abdomen increased to a great degree, and she died on the 30th of July.

The kidneys were sent to me for examination.

They were about one-half the natural size. One weighed 2 oz. 3 dr., the other only 2 oz. They presented the usual appearances of the contracted granular kidney. The granulations on the surface were white and firm, varying in size from a pin's head to a pea. One was injected through the artery before being subjected to a microscopic examination. Many tubes were entirely denuded, some were slightly dilated, some contained granular particles of disintegrated epithelium; no healthy tubes could be seen. The coats of the arteries and of the Malpighian capillaries were much thickened, the two fibrous layers of the former remarkably hypertrophied. In some cases the injection had completely filled the Malpighian capillaries, in others it stopped at the end of the afferent artery; while in other instances the canal of the artery was occupied by oil globules, and no injection had entered it. Many Malpighian bodies were shrunk, their capsules corrugated with oil globules in or upon the capillaries. The inter-tubular capillaries being uninjected, were not visible.

Case XIII.

Sudden suppression of urine (*Ischuria renalis*) without previous symptoms; peritonitis; death in 48 hours. — Extensive destruction of the secreting tissue of the kidneys; tubes denuded, &c., the result of chronic desquamative disease.

I am indebted to Dr. Todd for the brief history of the following case, and for the opportunity of examining the kidneys. A solicitor, æt. 45, residing in the neighbourhood of London, had usually enjoyed good health; his habits were temperate, and he had not suffered from gout. He went to bed apparently in his usual state of health on the 30th of June, 1847, having previously taken three or four wine glasses of brandy-and-water. In the night he awoke with a severe rigor, which was followed by a violent pain in the abdomen. His ordinary medical attendant was called to him, and found him suffering from symptoms of acute peritonitis; the abdomen was distended, bowels costive, no vomiting; he could pass no water, and a catheter introduced into the bladder drew off only about one ounce, which was not examined chemically. Six ounces of blood were taken from the arm, thirty leeches were applied to the abdomen, and some mercury was administered. Dr. Todd saw him on the morning of the 2nd of July. The symptoms were the same as on the day before; severe abdominal pain being the most urgent. The bowels were costive, and no urine was passed. He died about the middle of the day, retaining his consciousness throughout.

Inspection, on the 3rd of July, about twenty-four hours after death. The cavity of the peritonæum contained a small quantity of liquid; the whole membrane, parietal and visceral, presented appearances of active congestion, and there were one or two small patches of lymph. The jejunum was dilated and distended with a yellowish liquid ; the dilatation terminated abruptly just above the ileum, the lower part of the small intestine being contracted and empty. A very decided urinous odour was perceived when the abdomen was opened, so that it was at first supposed that the bladder had been ruptured, and that the urine had escaped. Such, however, was not the case; the bladder was found much contracted, and did not contain sufficient urine for testing.

The kidneys were sent to me for examination. Their size was normal, the surface smooth ; on a section, the structure appeared to the naked eye unnaturally confused and indistinct; there was no decided appearance of morbid deposit, and a careless observer might, perhaps, have considered them healthy, or at the most but slightly diseased. One contained a cyst, in its substance about the size of a hazel nut.

On a microscopic examination, very few healthy tubes could be found, many contained a great amount of recently formed epithelium, which had been thrown off by desquamation ; others contained epithelium in process of disintegration, and many tubes were entirely denuded.

Remarks.—The kidneys afforded unequivocal evidence of chronic disease which had existed for many weeks, perhaps even for many months; so insidiously had the disease advanced, that its presence had never been suspected. The history of the patient is imperfect: he had considered himself in good health, and had not consulted his medical attendant before the sudden accession of urgent symptoms. An examination of the urine would probably have detected the latent mischief. The brandy was, without doubt, the immediate cause of the sudden arrest of the renal secretion. The case will serve to show the extent to which a destructive disease of the secreting tissue may proceed before any urgent symptom occurs; it will be apparent, too, that a careful chemical and microscopic examination of the urine should always be made when there is any reason to suspect the existence of renal disease.

Case XIV.*

Sudden attack of paralysis followed by coma; suppression of urine; death in 24 hours. — Cerebral congestion, with slight softening of corpus striatum.—Extensive destruction of secreting tissue of kidney; tubes denuded, &c., the result of chronic desquamative nephritis.

A tradesman of middle age was apparently quite well on the morning of his attack, but during the day complained of headache and nausea; in the evening, while sitting quietly, he was suddenly taken with faintness, and then sent for his medical attendant, who found him paralyzed on the whole right side; he was quite sensible, and able to talk; pulse very feeble, and pupils contracted. He was cupped, and cold was applied to the head. In about two hours afterwards, he became suddenly quite insensible, had stertorous breathing, and inability of swallowing. He remained in this state twenty-four hours, and then died, the pupils remaining contracted the whole time. From the time of his attack until his death he passed no urine; a catheter introduced into the bladder drew off nothing. It appeared that he had passed no water since he got up in the morning. A friend with whom he very frequently spent the evening over the bottle, said that he had

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* I am indebted to my friends, Dr. Todd and Dr. J. Duncan, for the particulars of this case, as well as for the opportunity of examining the kidneys.

often wondered how he managed to go so long without passing water. He had never complained of pain in the loins. He had been rather a free liver, and had suffered from anxiety in his business.

Inspection.—The head and the kidneys were the only parts examined. There was considerable congestion on the surface of the brain, but no clot either at the base or in the substance of the organ. A small quantity of serum existed at the base and in the lateral ventricles. The grey matter everywhere was very dark. The corpus striatum on the left side was rather soft, the optic thalami were very dark coloured. The arteries were healthy, except the basilar, which presented three or four dilatations, causing the vessel to appear nearly three times the natural size. The only note which I made of the kidneys is, that many tubes were denuded, and that others were filled with epithelial cells. There was thus sufficient evidence of the existence of chronic disease, which had proceeded to the extent of destroying a large proportion of the secreting structure of the kidney, without being suspected by the patient or his friends. It is interesting and instructive to compare the case with No. 13, p. 302. The condition of the kidneys in the two cases was identical. In both cases, the progress of the disease was insidious and unsuspected, until the function of the kidney was suddenly suspended; as a consequence of which, in the one case, the brain was the organ which suffered, and in the other the peritoneum.

Case XV.

Acute nephritis passing into chronic desquamative disease, with granular casts in the urine; subsequently a waxy deposit in the kidney, with waxy casts in the urine; scanty secretion; pericarditis, pleurisy, death.

John Revels, æt. 30.—Labourer, employed by the New River Company; much exposed to wet and cold at his work. Of temperate habits. About seventeen years ago he had dropsy, and 'swelled very big.' He thinks he was ill about a month; he recovered completely and remained well, with the exception of an attack of influenza about twelve years ago, until about seven or eight months since, when he got wet through at his work and had to stand for five or six hours in his wet clothes. He felt 'chilly and shivering, and miserable,' and from this day he dates the commencement of his present illness.

His wife considers that he has never been quite himself since the death of their only child, about two years ago. When he saw the child expire, he uttered a loud scream, and said he should never be happy again; and from this time he appeared to droop and to lose strength, but she agrees with him in attributing the commencement of his actual illness to the wetting above mentioned. The earliest symptoms were oppressed breathing with headache; the latter has continued till the present time; he has gradually grown pale and weak, has lost flesh, and has had occasional slight swelling of the face and hands. About six weeks ago he began to have pain in the stomach and flatulence after eating. About a month ago he had bleeding from the nose, which lasted four hours, and weakened him very much; before this accident he suffered much from dimness of sight, a symptom which has since disappeared, as well as some puffiness of the face which previously existed. He has discontinued his work on account of weakness since the bleeding.

He reports of his urine that at the commencement of his illness it was very high coloured, 'like porter;' it was at the same time scanty; it soon recovered its natural appearance, and became more abundant; he has sometimes got up four or five times during the night to pass water, and has passed as much as three quarts in twenty-four hours.

The preceding narrative brings the history of the patient to 17th November, 1847, when he first came under my observation. It was then noted that he is of middle height, muscular, but the muscles flabby; light hair; face and lips very pallid. He complains chiefly of weakness and slight headache; breath short on making any exertion, no cough, sounds of the heart normal, pulse 88, skin cool, tongue clean, no thirst, appetite good, but he feels very uncomfortable for an hour or two after eating. Bowels costive. A short time since his sleep was disturbed by sudden starting and dreams; he now sleeps more quietly. Urine about four pints in twenty-four hours, pale, sp. gr. 1012; deposits a rather abundant, dense, whitish precipitate, composed of dark granular casts (probably disintegrated epithelium), some scattered renal epithelium, no blood or crystals. Albumen in small quantity.

The nature and the amount of sediment at this time indicated chronic desquamative disease rapidly progressing.

He was admitted into Sutherland ward on the 20th of November. On the 24th and 26th the urine was again examined, with the same result.

On the 27th he was made out-patient at his own request, and on the 4th of December he was re-admitted, having been seized with shivering, followed by hoarseness and cough, with scanty expectoration. Tongue dry in the centre. Pulse 80. No dropsy of the limbs or belly; face pale and rather puffed, countenance heavy; feels drowsy; complains chiefly of weakness.

December 11th.—The urine has the same character as before; during the last twenty-four hours the quantity passed was four pints (16 oz.) and 4 oz.

He occasionally vomits after his meals.

December 16th.—To-day, for the first time, I observed the 'large waxy casts' in the urine (see p. 185), mixed with the dark granular casts before mentioned. The waxy casts entangled some small bodies like pus-cells, but differing from them in not showing the compound nuclei with acetic acid. Some of the same bodies were scattered about the field.

On the 20th the waxy casts were more numerous in proportion to the granular casts. The urine had a sp. gr. 1012. Albumen moderately abundant. On the 27th the legs were swollen, and pitted on pressure; he complained of headache. On the 1st of January he had shortness of breath, uneasiness about the heart, heart's action tumultuous. Pulse 96.

January 4th.—Feels weaker, countenance anxious, frequent vomiting, a loud double friction sound over the heart, pulse 120, resp. 32. Passes less urine, perspires freely. On the 5th he felt that he was beyond hope of recovery, and insisted on being removed to his home, where he gradually sunk. The urine became very scanty; once a catheter was passed, under the idea that the secretion was retained in the bladder, but scarcely any was found there; at length he became delirious, and died on the 11th of January.

Inspection, two days after death.—Body well formed, muscular, very little emaciation, skin very pallid. The pericardium contained a moderate quantity of serum; the surface of the heart was roughened with recent lymph; heart large; left ventricle dilated and its walls very thick. Valves all healthy. Some lymph on the right pleura in contact with the pericardium. Lungs congested; in other respects healthy.

Kidneys.—The cortical substance thinned, and containing a yellowish-white, firm, waxy material, which, on the surface, formed projecting granules, varying in size from a pin's head to a large pea. In parts where this material was most abundant, the tissue was anæmic; where less abundant, the vessels were congested. On the surface of one kidney there was a cyst the size of a large pea. Some of the tubes were crowded with epithelium, some contained granular particles of disintegrated epithelium, others were denuded, and again, others contained the same waxy material which had formed the casts already described as existing in the urine.

Remarks. — This case is an example of chronic desquamative disease supervening upon—what the reported characters of the urine indicate to have been in the first instance—a mild attack of desquamative nephritis; and it shows the danger of neglect and exposure in such a case. When the poor man first came under my observation, the disease was so far advanced, and was progressing so rapidly, that no treatment could be of any avail; but if at the commencement of the attack he had been subjected to proper discipline, which would have implied an immediate discontinuance of his work, and careful protection from wet and cold, there is reason to believe that he might soon have been restored to health.

One of the most interesting points in this case is the observation of the first appearance of the waxy casts in the urine, their mixture with the granular casts, and subsequently the increased number of the former in proportion to the latter; their appearance in the urine being doubtless simultaneous with the deposit of the white waxy material in the kidney, and the material being probably secreted by those tubes which had previously lost their epithelial lining. (See p. 215.) The dilatation of the left ventricle of the heart, and the hypertrophy of its walls, all the valves being quite healthy, are probably to be explained by the impeded circulation through the systemic capillaries consequent on the morbid state of the blood produced by the renal disease.

It is worthy of remark, that although the exciting cause of the acute nephritic attack was exposure to wet and cold, a predisposition to be thus affected had probably been induced by the long continued mental depression from which he had been suffering. It is an undoubted fact, that the depressing passions diminish the vital energy of the body, and so lessen its power of resisting noxious influences.

The attack of dropsy which he had seventeen years before his death was probably connected with acute nephritis, and appears to have ended in complete recovery. The case affords an illustration of the apparent tendency to a recurrence of acute nephritis on any repetition of the exciting cause. It is probable, however, that there may have been no connexion whatever between the first and second attack, and that few persons in perfect health would escape a similar illness in the same circumstances as those which gave rise to his last fatal attack.

Case XVI.

Intemperate habits; frequent attacks of gout, and one or two of delirium tremens; mental worry, followed by restless nights and spectral dreams; urine albuminous, and containing *granular and large waxy casts.*—Epileptic convulsions, delirium, coma, and death.—Kidneys small; tubes with disintegrated epithelium; Malpighian capillaries and arterial walls thickened.

George Addis, æt. 43, a waiter. Applied to me as an out-patient at King's College Hospital, on the 29th of November, 1849. His habits had been intemperate; he had frequently suffered from gout, and once or twice from delirium tremens. About seven weeks before, he was robbed of rather a large sum of money, which was taken from his pocket during a fit of intoxication; since this occurred he had rapidly declined in health and spirits. He had slept very little, and had been much disturbed by spectral dreams; on the 23rd of November he had a fit, which appears to have been of an epileptic nature. His face was pallid, and he had a very distressed and anxious look.

On the 1st of December he was worse, and being unable to attend as an out-patient, I admitted him into the hospital under the care of Dr. Todd. On the night of his admission he had another epileptic fit, and on the following day three fits occurred; he was restless, and soon became violently delirious. On the 4th, the urine was found to be highly albuminous, but it was not then examined microscopically. On the following day he was much weaker, and perspired profusely; the urine was passed with the stools. Early on the morning of the 6th December he had a convulsive fit, followed by coma, in which he died at half-past seven A.M.

After death the bladder contained several ounces of urine, which was drawn off and examined. It was of rather pale colour, sp. gr. 1015, highly albuminous; after standing, it deposited a slight sediment, which contained *granular casts* (fig. 11, p. 178,) in considerable numbers, and a few *large waxy casts.* One cast contained blood-corpuscles. No entire epithelial cells.

The kidneys were wasted; one weighed three ounces, and the other two ounces and a half. They were slightly uneven, and mottled by an apparent mixture of a white deposit with congested vessels. Some small spots of hæmorrhage on the surface and a few small cysts. Many tubes were opaque, with granular, disintegrated epithelium, having exactly the appearance of the *granular casts* which were seen in the urine. In some tubes the epithelium had a granular appearance, but the canal of the tube was entire, indicating a less degree of disease than in those tubes which were filled with completely disintegrated cells. There was scarcely any appearance of desquamation. A *very few* tubes were quite denuded, and some contained blood.

The Malpighian capillaries were opaque and thickened, and some had oil-globules either in their canals or on their walls The two muscular coats of the arteries were hypertrophied. The canals of some of the thickened arteries still contained blood, but some were filled with oil-globules, which clearly indicated that the circulation in them had for some time been arrested.

The left ventricle of the heart was hypertrophied, and there was some thickening of one aortic valve. The blood was very liquid. Dr. Todd reports of the brain,* that 'upon careful examination it afforded no marks of disease; the membranes were healthy; the grey matter of the convolutions pale.'

There was no appearance of dropsy in any part of the body.

Remarks.—This case is a good example of that form of chronic inflammation of the kidney which is commonly associated with the confirmed gouty diathesis. The appearances observed in the urine corresponded exactly with the condition of the kidney. The state of the bloodvessels indicated the different degrees of change which they undergo as a consequence of the destruction of the secreting cells; some vessels having thickened walls but being still pervious, while others had an accumulation of oil in their canals. The destruction of the secreting tissue was less complete than in the case of Hewson (No. 11), and he would probably have lived much longer if he had not been struck down by the mental anxiety under which he was labouring for some weeks before his death.

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* *Lectures on Delirium and Coma. Med. Gaz.* 1850.

His intemperate habits and the renal disease had so far diminished his vital powers, that he succumbed under a mental shock, from which, probably, a healthy man would quickly have recovered. The delirium and the epileptic convulsions, followed by coma, were natural consequences of the conjoint influence of mental emotion and impure blood.

The opacity of the aortic valve did not appear sufficient to explain the hypertrophy of the left ventricle, which was probably a result of the impure condition of the blood, and the consequent impeded circulation through the systemic capillaries. (See p. 246.) If the degree of hypertrophy may be taken as a measure of the amount of capillary obstruction which had to be overcome, it will be apparent that, as in this case, there was no dropsy, the occurrence of that symptom must be influenced by other conditions—the state of the blood as to the proportion of its solid and liquid constituents being, probably, an important element. (See p. 252.)

Case XVII.

Occasional attacks of gout. — Chronic bronchitis.— Urine slightly albuminous, and containing numerous granular casts.—Death preceded by convulsions.—Kidneys wasted, some tubes being filled with disintegrated epithelium, and others quite denuded.

Benjamin Hobday, æt, 47, a waiter, with sandy hair and pallid skin, was attended by me as a dispensary patient, in

January, 1847. He had been in the habit of drinking freely, and had several times suffered from gout. About three months before I first saw him, his wife had observed that his abdomen became tumid, and his face rather puffed; this soon subsided, and there was no subsequent appearance of dropsy.

His present illness began, about six weeks before I saw him, with cough and mucous expectoration. There was large crepitation over both sides of the chest. He was losing flesh; he always appeared dull and heavy; and his tongue was dry and brown. He took an antimonial mixture without relief. The urine was scanty and high coloured; it contained a small quantity of albumen, and *numerous dark-brown, opaque, and granular casts, apparently composed of disintegrated epithelium.* No blood-corpuscles were observed.

January 25th.—He had several attacks of convulsion, in the intervals of which he lay muttering and insensible. On the following day he died.

Inspection.—The brain and its membranes appeared quite healthy. The lungs contained scattered crude tubercles, and were much engorged and carnified. The kidneys presented the characteristic appearances of chronic desquamative nephritis. The cortical substance was wasted, and its surface irregular and granular. Some tubes were crowded with cells, differing little in appearance from the normal epithelium, while the greater number of the tubes contained granular and disintegrated particles, evidently identical with those which had formed the casts observed in the urine during the life of the patient. Other tubes, again, were pale and transparent, being composed only of basement membrane, and so presenting a cyst-like appearance (fig. 14, p. 212). It was apparent that these tubes had lost their epithelial cells, which probably had first become disintegrated, as in the tubes just now mentioned, and subsequently the particles had been washed out by the current of liquid passing through the tubes, and so had formed the *granular casts.*

At that time I had not particularly observed the condition of the bloodvessels, and I made no note of their appearances.

ADDITIONAL OBSERVATIONS ON THE ORIGIN OF RENAL CYSTS.

I have before stated (p. 219), that some pathologists take a different view of the cyst formations in the kidney from that which I have adopted. Mr. Simon, in a paper 'On Sub-acute Inflammation of the Kidney,'* maintains that the cysts in question are abnormal developments of epithelial germs; his theory being, that 'Certain diseases of the kidney (whereof sub-acute inflammation is by far the most frequent) tend to produce a blocking of the tubes; that this obstruction, directly or indirectly, produces rupture of the limitary membrane; and that then, what should have been the intra-mural cell-growth continues with certain modifications as a parenchytic development.'

It happened that Mr. Simon's paper, and one by myself, 'On the Inflammatory Diseases of the Kidney,' were read before the Medico-Chirurgical Society on the same evening, and the two papers now appear in juxtaposition in the Society's *Transactions*. A reference to the illustrations which accompany the papers will show that both Mr. Simon and I had seen and described, essentially, the same appearances, and that the difference between us consists in the interpretation of the phenomena.

The great imperfection in Mr. Simon's theory is, that it gives no account of the relation of these so-

* *Med. Chir. Trans.* vol. xxx.

called 'fluid-holding cysts' to the tubes, nor of the manner in which the tubes entirely disappear, as they are supposed to do, and are replaced by cysts having, as is acknowledged, the same relation to the vascular plexus of the gland.

I am indebted to Mr. Simon for having first pointed out to me the cyst-like appearances in microscopic specimens of renal disease, and I have now notes of more than one specimen in which what I called 'Simon's cysts,' were observed; for at that time I had no doubt as to their vesicular nature. But when I examined the appearances more carefully, with a view to ascertain the relation of the supposed vesicles to the tubes, I was perplexed by the apparent impossibility of determining the point. Where the vesicular appearance existed, there seemed to be no trace of tubular structure, but each mesh of the matrix, in which, normally, a portion of tube should have been seen, was filled, apparently, by a single vesicle: the tube had, as it seemed, disappeared entirely, and had been replaced by a vesicle having precisely the same relations to the surrounding tissues as the tube would have had, if it had not, in some mysterious way, disappeared.

The next step towards a solution of the problem was an observation which I made and recorded, that the cells appeared to undergo a process of *elongation*, so that while some were globular, others appeared oval, and others again were so much elongated as to have a tubular form. But even then, so possessed was my mind with Mr. Simon's interpretation of the appearances, that I failed to identify them with the tubular structure, and I made a rough sketch of the supposed cells in various degrees of elongation, with a query, 'What is the nature of these cells?'

Shortly after the last-mentioned observation was made, I examined another kidney, in which precisely the same appearances were noticed; and while looking at the specimen, it suddenly occurred to me that the structures which I had hitherto supposed to be vesicles, were in fact tubes, which had been rendered transparent by the loss of their epithelial lining—a conclusion to which I was assisted by observing the opaque granular casts, composed of disintegrated epithelium, which had appeared in the urine. For it was evident that the material in question, when crowded into the tubes, rendered them opaque, while its removal by the current of liquid from the Malpighian bodies gave the tubes, composed now only of denuded basement membrane, the transparent and cyst-like appearance which had hitherto perplexed and deceived me. I could then understand the difficulty which I had before experienced in my attempt to ascertain the relation of the tubes to the supposed cysts; for since the cyst-like appearance was simply the result of the tubes becoming transparent in the manner described, and since the same tubes could not have at the same time an opaque and a transparent appearance, it was obvious that the tubes and the supposed cysts could not coexist in the same place, but that they must necessarily replace each other. There was now no difficulty in tracing the steps by which the tubes gradually assume the transparent appearance as they lose their solid contents, and then either grow into cysts, or dwindle down to invisibility. Then, too, I could explain another appearance which the vesicle-theory had failed to account for; I allude to the fact, that the supposed vesicles appear to occur in groups, all the members of each group having the same appearance, although the various groups differ greatly from each other; so that whatever peculiarity of size or of contents marks one member of a group is repeated in all the individuals of that cluster. This received no explanation from the vesicle-theory, but it was immediately intelligible when it was seen that the appearances which had been mistaken for clusters of vesicles, were simply the result of a continuous tube, taking a tortuous, convoluted course, and being alternately concealed by the fibres, and visible in the meshes of the matrix in which it is packed. A reference to fig. 9, p. 94, will show the extreme tortuosity of the tubes, so that numerous turns and convolutions occur in a space which might be circumscribed by a circle. On the other hand, the appearance of what seems to be a single vesicle in the midst of renal tissue, is no proof that it is not a portion of tube, for I have seen this in the kidney of the newt, when its tubular nature has been unequivocally shown by the action of the cilia within it. A single knuckle of tube has thus come into view, while its continuation on either side has been concealed by the surrounding tissues.

I have frequently seen the branches of the renal arteries present appearances which might readily be mistaken for cysts with thickened walls, some being seen in section, and others suddenly bending away and passing out of focus. These appearances are very common when the arteries are tortuous, as they often are, in the advanced stages of chronic inflammation of the kidney.

Mr. Simon's remark, that 'from the smallness attained by the cysts it seems quite obvious that they cannot commence in any transformation of the tubes themselves,' is at once met by the observation, that the tubes, after the destruction of their epithelium, frequently waste and dwindle down to a point at which they can scarcely be recognised from their smallness. (See fig. 15, p. 213.) These changes in the tubes have escaped Mr. Simon's observation, and hence the error into which, as I believe, he has fallen in his interpretation of the appearances in question.

Again, I have never observed, as a consequence of chronic inflammation of the kidney, any indication of rupture of the basement membrane of the tubes—a condition which Mr. Simon assumes as the antecedent and the cause of the supposed monstrous development of the epithelial germs. On the contrary, I have shown that the basement membrane remains entire throughout all the stages of the disease, and that it forms the walls of the cyst-like bodies.

A further objection to the vesicle-theory is, that the formation of the supposed vesicles appears to be entirely purposeless; for we cannot admit as a satisfactory reason for their development, Mr. Simon's suggestion, that they 'are organized for secretion into their own cavities, so as at least to withdraw from the blood, if they cannot eliminate from the body, the materials which fill them.' If we consider the very small amount of good which could in this way be effected by the largest and most numerous collection of cysts, we cannot but perceive that there is so great a disproportion between the benefit which can possibly be conferred, and the means by which it is supposed to be accomplished, as to give to the process an appearance of being very unnatural. On the other hand, that interpretation of the phenomena for which I contend, shows that the appearances in question form one link in a chain, the entire tendency of which is salutary.

It is probable, as I have before suggested, that the denuded tubes assist in eliminating the abundant stream of liquid which characterizes the disease in question, and which has the effect of lessening the tendency to dropsical accumulation in the body; while the occasional dilatation of the tubes into cysts may be considered as an accidental occurrence, resulting, as is probable, from obstruction of the lower parts of the tubes, and a consequent impediment to the escape of their contents.

Although, for the reasons adduced, I dissent from Mr. Simon's theory of cystic degeneration of the kidney, I am not insensible of the great merits of his paper, which contains a very lucid, and, for the most part, a correct exposition of the subjects of which it treats.

Since the appearance of Mr. Simon's paper, Professor Rokitansky has published a monograph,* in which he adopts Mr. Simon's explanation of the renal cysts, and the same theory has received the weighty approval of Professor Paget,† to whose kindness I am indebted for the opportunity of examining Rokitansky's paper. The appearances represented in the Austrian professor's drawings are such as I have observed in numberless instances, and they are essentially the same with illustrations which had been before given by Mr. Simon and myself, but Rokitansky has fallen into the very grave error, of representing the normal fibrous matrix of the kidney as a product of disease. The matrix appears in his illustrations as it may be seen in every healthy kidney, and on referring to the description of the appearances in question, we find it stated that 'the most striking of the cysts have a wall, consisting of layers of fibres scattered over with curved nuclei;' and again, 'the cysts lie in a stroma, which seems to develop itself gradually into a fibrous structure circumscribing the cysts.' This is an exact description of the healthy matrix, and corresponds with the account which has been given of the tissue in the introductory chapter of this volume. The appearance of one cell being placed concentrically within another, which is represented in some parts of Rokitansky's drawings, is an optical illusion which may frequently be seen in undoubted uriniferous tubes. The appearance in question may often

* *Ueber die Cyste.* Wien. 1849.

† *Lectures on Tumours. Med. Gaz.* 1851.

be observed in transverse sections of the straight tubes in the medullary cones; the orifice of the tube next the eye appears large, and the distant one small, as in looking through a long tube, or a tunnel. I have sections of the medullary cones which show this appearance in a very striking manner.*

In short, there are two serious defects in the history which Rokitansky has given of the development of renal cysts, the one arising from an insufficient regard to the normal structure of the kidney, and the other from inattention to the peculiar appearances assumed by the tubes, partly resulting from their relations with the other tissues, and partly as a consequence of changes in the tubes themselves.

Dr. Gairdner† has given representations of what he supposes to be 'vesicles dispersed amid the normal elements of the kidney;' but he has not indicated the marks of distinction between these appearances and the structures which he represents as tubes in his first and ninth figures. The structures appear to me identical, although the contents of the tubes vary in the different specimens.

I am not prepared to deny that cysts are ever

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* Another deceptive appearance may sometimes be observed in looking through the canal of a straight tube whose walls are white and glistening: the fore-shortened inner surface of the tube gives the appearance of a very thick wall. The actual thickness of the wall may be seen by carefully adjusting the focus, or by examining the tubes in a transverse direction—*i.e.*, by light which has passed through the walls of the tubes in a direction at right angles to their axes.

† *Contributions to the Pathology of the Kidney*, figs. 19 and 20, p. 47.

formed in the kidney by the abnormal development of epithelial or other germs. As yet, however, I have met with no proof of such a mode of cyst-formation, while, on the other hand, I have adduced sufficient evidence to show that the dilatation of the tubes and their growth into cysts is a very common process.

I have more than once heard it stated that the renal cysts may be detached from the surrounding tissues and made to roll over in a liquid under the microscope; but I have examined many kidneys with much care, and I have never seen such an appearance.

DEVELOPMENT OF NEW FIBROUS TISSUE.

In describing the morbid anatomy of chronic nephritis, I have made no mention of new fibrous tissue, because, although appearances of such development sometimes present themselves in the kidney as in almost every other organ, yet I am persuaded that this is an unessential, and, indeed, an accidental phenomenon; and that it has no important share in producing the atrophy, or any other of the characteristic features of the disease. When the tubes are much wasted, as in fig. 15, p. 213, the meshes of the fibrous matrix (fig. 3, p. 17) are necessarily contracted, and the fibres consequently appear thicker and more abundant, but the structure and general appearance of the tissues are essentially the same as in the normal state.

There can be no doubt that this normal tissue has repeatedly been mistaken for a product of disease. I frequently made this mistake myself, until, with reference to this point, I had more carefully examined the minute structure of the healthy kidney. Henle is of opinion that the formation and subsequent contraction of fibrous tissue is the weightiest element of Bright's disease;* and in a report of the appearances observed in a diseased kidney,† he describes what he takes to be new fibrous tissue, in language which is so exactly applicable to the normal tissue, that I have no doubt as to their identity, especially as there is not a word to indicate that he is aware of the possibility of mistaking the fibrous matrix for a diseased product.

Frerichs considers the development of new fibrous tissue a rare and unimportant phenomenon, but gives a drawing of the appearance, which is, in fact, a correct representation of the fibrous matrix as it normally exists in the medullary cones. The drawing to which I refer is fig. 28 in his plate. Frerichs, however, doubts the existence of even the normal fibrous matrix (*op. cit.*, p. 14); a piece of scepticism which I am at a loss to account for.

The opinion of Mr. Simon,‡ as to the development of new fibrous tissue, that it is a rare and doubtful phenomenon, is entirely in accordance with my own observation.

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* *Handbuch der rationellen Pathologie,* band ii. p. 305.

† *Zeitschrift für rationelle Medicin,* band i. p. 68.

‡ *Med. Chir. Trans.* vol. xxx. p. 155.

CHAPTER V.

WAXY DEGENERATION OF THE KIDNEY.

WHEN describing the condition of the urine in acute desquamative nephritis, I stated, that besides the epithelial casts, which are characteristic of the disease, there may occasionally be seen some casts of larger diameter, about $\frac{1}{500}$ of an inch, and of a different character; these casts are represented at p. 185, under the name of 'large waxy casts.'

The appearance of a few large waxy casts during the progress of acute desquamative nephritis is a very common occurrence, so much so, that I believe they may be seen in the majority of cases; but their number is usually very small in comparison with the epithelial casts, the proportion varying somewhat in different instances. All the patients in whose urine I have observed these casts, together with the epithelial casts, have recovered, so that I have had no opportunity of examining the kidneys. There can be no doubt that in the event of a fatal termination, some of the tubes would be seen filled with the waxy material, as in the chronic case of Revels (No. 15), and it is clear that those portions of the tubes which contain the material in question must have lost their epithelium, since the casts have the full diameter of the uriniferous tubes; this being about twice the diameter of those casts which are formed in such tubes as still retain their epithelial lining (p. 352). It is a question not without interest, whether the tubes which have thus become filled with an unorganized material may regain their normal epithelium, and so continue to discharge their secretory functions. I believe that this question admits of an affirmative answer, and my opinion is chiefly based upon the history of the following case, in which there were most of the symptoms of acute nephritis, but all the casts were of the 'large waxy' kind, and no renal epithelium appeared in the urine.

Case XVIII.

General dropsy from intemperance and exposure to cold; urine highly albuminous, and sometimes very bloody; numerous 'large waxy casts,' without epithelium.—Complete recovery.

Thomas Hayden, æt. 20, a carpenter, of not very temperate habits, was admitted into the hospital, under the care of Dr. Todd, on the 13th of November, 1847, with general dropsy. He stated that he never had any serious illness before the present attack. About a month ago he got wet through and worked in his wet clothes; all day he felt very cold, and had rigors. Within a week afterwards the ankles began to swell, and the swelling extended and increased. A fortnight ago he first observed that he passed water oftener than usual, getting up several times in the night for that purpose; at the same time the quantity was diminished. He had pain in the loins, and a feeling of constriction in the lower part of the chest, and the heart beat quicker than usual. He lost his appetite, and once before his admission he vomited his dinner.

On the 14th of November it was noted that he is a stout man, but with flabby muscles. There is general dropsy in a moderate degree; some liquid in the abdomen; sounds of heart and lungs normal; no enlargement of the liver; tongue rather white; pulse 84. Urine about three pints in twenty-four hours, sp. gr. 1010, becoming almost solid with heat and nitric acid. *It deposits a whitish sediment, containing numerous 'large waxy casts,' in some of which are entangled small cells, having the appearance of pus, also a considerable number of the same cells scattered, and some in irregularly-shaped clusters. Scarcely a particle of renal epithelium. No oil.*

Yesterday a small quantity of blood was taken by cupping from the loins. He was ordered Pulv. Doveri, gr. x., om. n., M. mag. c. mag. sulph. ℥i. om. m.

To have a hot-air bath every other morning, and milk diet.

On the 15th the urine was *slightly smoky from blood, and on the 18th and 19th it contained a large quantity of blood.* This soon disappeared, and on the 24th its microscopic characters were exactly the same as noted on the 14th; it contained no blood. Albumen still very abundant, sp. gr. 1021; about three pints in twenty-four hours. No remains of the dropsy. He feels weak, is pallid, and has lost flesh. Tongue clean; no thirst; appetite good; no pain or discomfort after eating; bowels open once a day; skin cool and moist. Has continued the same remedies. To have middle diet, with 4 oz. of bread extra.

On the 26th the albumen was diminished and the casts and small cells were much less numerous.

December 4th.—For a day or two since the last report there has been a return of the blood in the urine. The colour is now nearly natural. Quantity of urine the same, sp. gr. 1020. *A very small quantity of albumen.* An abundant brownish-white sediment, composed chiefly of crystals of lithic acid, with a few 'granular casts' (probably the 'waxy' material disintegrated), and some scattered pus-cells. No epithelium. He feels better and stronger. No dropsy.

He was made out-patient, but did not attend, probably in consequence of feeling quite well.

In the spring of the following year he sent for Dr. Armitage, who had been resident medical officer while Hayden was in the hospital; he had been quite well in the interval, but was then suffering from typhus fever; he had no dropsy, nor any symptom of renal disease. He was transferred to the care of the parish surgeon, and from that time I have not heard of him.

It will be seen that the general symptoms of this disease were very like those of acute desquamative nephritis, but the renal casts were remarkably different. When I first saw these casts in Hayden's urine, I gave an unfavourable prognosis, for I thought it very unlikely that the uriniferous tubes could return to a normal condition after being filled, as many of them must have been, with the unorganized material which formed the casts. The history of the case leaves but little room for doubt that he did recover very completely. The disease was acute, and evidently of very recent origin; and this is the circumstance which, in a similar case, would induce me to give a hopeful, though still a guarded, prognosis. It is clear, from physiological considerations, that the risk of a fatal arrest of secretion must be greater when the tubes are being filled with an unorganized material, than when there is that slighter departure from the normal action of the glands, which is indicated by a desquamation of epithelium. The abundant hæmorrhage which occurred in this case was evidence of greatly impeded circulation. It was also an indication that the disease was of recent origin, for it will presently be seen, that in the chronic forms of waxy degeneration of the kidney, the Malpighian capillaries undergo the same process of thickening as in cases of chronic desquamative disease; a condition of the vessels which renders hæmorrhage a rare, and almost an impossible occurrence. (See p. 234.)

There is reason to believe that the escape of blood in the case of Hayden, as in all similar instances of disease, afforded relief to the circulation by emptying some of the over-distended Malpighian vessels. The presence of blood in such circumstances may therefore, for the reasons above mentioned, be considered as of favourable import.

The small cells resembling pus-corpuscles, which are noted as having been present in the case of Hayden, some entangled in the casts, and others scattered or irregularly clustered, are usually associated with the large waxy casts. They have somewhat the appearance of the nuclei of epithelium, and it is not unlikely that they are abortive epithelial germs.

In giving the history of chronic desquamative nephritis, I mentioned the deposit of the waxy material in the tubes as one of the later and secondary results of the disease (p. 215). With reference to this form of waxy deposit in connexion with chronic desquamation, I have nothing to add to what has there been said.

A chronic disease characterized by the gradual degeneration of the epithelium of the kidney into the waxy material in question, may occur without being preceded by, or associated with, the true desquamation, either in an acute or a chronic form, or certainly when the desquamative process forms a very small part of the disease. The following case is a good illustration of an extreme degree of chronic waxy degeneration of the kidney. The patient was under observation only a very short time, and the history is less complete than could be wished, but there is much in it that is instructive.

Case XIX.

Dropsy after scarlatina, followed, during two years, by a continuance of ill health, with occasional dropsy; finally, drowsiness, epilepsy, and death. —Kidney much enlarged, and anæmic, with an abundance of waxy material in the tubes; Malpighian capillaries opaque and thickened.

Jane Gatenby, æt. 28, wife of a costermonger, was admitted into King's College Hospital, in July, 1849. The late Mr. Duncan Fergusson, who was resident medical officer at the time, supplied me with the following brief notes.

'When she came in she was unable to speak, and appeared almost comatose; she had great difficulty in breathing, accompanied by a loud stridulous noise; complained, by shrieks, of pain in the stomach and across the kidneys. In a few hours she had an epileptic fit, after which she remained stupid for some time; on the same day she had a second fit, and on the following day she had another, after which she died in a state of coma. She passed no urine.

It appeared that two years before, she had scarlatina, followed by partial anasarca, and some months after she felt her health declining. She used to complain of prostration of strength, headache, flatulence, pain across the loins; the urine was passed frequently, but in small quantity. After a time, about three months ago, she applied for advice on account of dropsy, which was relieved by purgatives; but she never felt well afterwards; she appeared unwilling to look after her domestic affairs, and was very drowsy and stupid.

Inspection, twenty-four hours after death.—The brain was not perceptibly diseased. Lungs congested. Considerable œdema of the glottis; liver congested. Kidneys much diseased; one sent to the College Museum, the other to Dr. Johnson.'

The one sent to me was much increased in size, and weighed nine ounces. The cortical substance was of a yellowish-white colour, and had a very wax-like appearance; scarcely a trace of lobular structure, and only a few vessels in small patches were visible on the capsular surface. The medullary cones were congested, and of a dark red colour.

On a microscopic examination, no healthy tubes could be found. Most of the tubes appeared to be filled with the wax-like material, which had taken the place of the secreting cells, no epithelium being found in the tubes which contained this deposit. Here and there the material, when pressed out of the tubes, had the appearance of 'large waxy casts' (p. 185). Some tubes contained an excess of rather small epithelial cells, and many of these were scattered about the field. A very few tubes contained oil. The Malpighian capillaries were opaque and thickened, having the appearances described and explained at p. 232. The condition of the other bloodvessels was not noted.

It appears that this patient had never completely recovered from the attack of renal disease, connected with scarlatina, which occurred two years before her death. She was under observation too short a time, and the history is altogether too incomplete, to admit of a positive opinion being given as to the original nature of the renal disease; but the condition of the kidneys renders it in the highest degree probable that the attack which followed the scarlatina was similar to that in the case of Thomas Hayden (p. 326), and that from the commencement there was a tendency to the waxy degeneration of the epithelium. This is a question which could have been positively decided only by an examination of the urine at the period referred to. But there were no appearances in the kidneys which indicated the previous existence of desquamative disease; and their greatly increased size and weight are opposed to the notion of chronic desquamation with its associated atrophy. (Compare, for instance, the condition of these kidneys with those in the case of Revels (p. 306). On the other hand, it appears in the highest degree probable that a patient who has once suffered from acute waxy degeneration would be liable to a recurrence of the disease, or that an acute attack would pass into the chronic form of disease; and it is of practical importance to remember that the danger of the latter event would be much increased by exposure to cold during the convalescence, or by a suspension of care and watchfulness before the recovery has been completed.

The condition of kidney which I have here called waxy degeneration, is not unfrequently found to co-exist with a precisely analogous disease of the liver in the same subject. This disease of the liver has been described by Dr. Budd* and others, under the name of *scrofulous enlargement of the liver*. A good example of the disease affecting simultaneously, though

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* *On Diseases of the Liver.* By George Budd, M.D., F.R.S.

in different degrees, the liver and the kidneys, is presented in the following case, the history of which is condensed from Dr. Budd's clinical lecture in the *Medical Times* of March 29th, 1851. The observations on the condition of the urine and on the post-mortem appearances in the liver and kidneys are my own; and the chemical analysis of the liver is by our friend, Dr. Lionel Beale, whose skill in analytical chemistry is highly appreciated by the medical officers of King's College Hospital.

Case XX.

Scrofulous disease of the hip; enlargement of the liver; urine very albuminous, and depositing a cloudy sediment, which contained a few 'large waxy' and some 'granular' casts.—A similar unorganized waxy deposit in liver and kidneys; secreting cells degenerated; Malpighian capillaries thickened.

Frederick Woodman, æt. 15, was a fair-haired lad, very intelligent, but small in stature, and crippled by scrofulous disease of the right hip. He was an orphan, and had spent all his life in London. Four years ago he came under the care of Mr. Fergusson, on account of 'morbus coxarius,' with abscesses in the upper part of the right thigh. The abscesses broke, or were opened, leaving fistulous openings, which continued to discharge matter up to the time of his death.

Some time after this, between three and four years ago, his belly began to grow large, but he noticed nothing further until about two years ago, when he observed a definite swelling, the result of a large liver, in the epigastric and right hypochondriac regions.

This continued, and in the middle of the year 1850 he came to Dr. Budd as an out-patient. The belly was then greatly distended, obviously in consequence of enormous enlargement of the liver and spleen. There were two fistulous openings in the upper part of the right thigh, which discharged freely.

Dr. Budd prescribed for him in succession, the oil of almonds as a substitute for cod liver oil, nitro-muriatic acid, and muriate of ammonia.

These medicines gave him no marked relief, and on the 30th of October he came into the hospital.

At that time he was very pallid, but not particularly thin. The belly was enormously distended, and large veins were seen on its surface passing up from the flanks. There was now evidently a small quantity of liquid in the peritoneal sac, but the large size of the belly was owing to the liver and spleen, the lower edges of which could be readily traced. His appetite was tolerably good, his tongue clean, and he slept pretty well; but his skin was dry, his pulse was above 100, and he complained constantly of thirst.

There had never been any jaundice, but there was now a faint sallow tinge in the conjunctiva. The urine was acid, and contained a large quantity of albumen, being rendered almost solid by nitric acid. On the 13th of November I examined it, and found that it had a sp. gr. 1013. When first passed it was clear, and of a pale sherry colour; after standing twelve hours it became turbid, with a light cloud, which, under the microscope, had an amorphous appearance. It contained very few casts of tubes: in the course of a very careful examination I saw one 'large waxy cast,' containing two or three nuclei, or small cells, one 'small waxy cast,' and one granular cast of medium size. There was no renal epithelium, nor any oil.

For more than a month after he entered the hospital no striking change in his condition occurred. He occasionally complained of slight pain at particular parts of the liver, which were then also slightly tender on pressure.

On the 19th of November the urine had an abundant sediment of lithic acid, which concealed all other appearances.

From that time I made no further microscopic examination of it. The quantity averaged about 48 oz., until the middle of December, when it began to diminish rapidly; so that on the 22nd of December he passed only 12 oz., the sp. gr. of which was 1015.

During the latter part of this time his appetite failed, and he was much purged, and frequently vomited. He complained also at times of headache. He gradually sank, and died, apparently from exhaustion, on the 29th of December.

The body was examined the next day.

The liver was much enlarged and its edges rounded. It weighed 8½ lbs., and in the body reached as low as the pubes. It was of a pale yellow colour, and pitted when pressed by the finger. It had no unnatural adhesions or false membranes, but its convex surface presented a few short linear fissures, which resulted, as Dr. Budd believes, from obliteration of small twigs of the portal vein and the consequent atrophy of the portions of liver which those twigs supplied. The gall-bladder was filled with viscid bile of an olive colour. The large gall-ducts were apparently healthy, as were the large branches of the portal and hepatic veins.

There was a small quantity of serous liquid in the peritoneal sac.

The spleen was very large and firm. It weighed 1½ lb.

The kidneys were large, weighing together 10 oz. They presented the same general appearance as the liver, but with a less abundant new deposit. On some parts of the capsular surface there were firm projecting nodules of the size of small split peas. The lobular markings were mostly obliterated, and there was very little appearance of vascularity.

The stomach and intestines were small and contracted, but presented no marks of disease; and the mesenteric glands were little, if at all, enlarged.

There were adhesions of the pleura on the right side, but the lungs and the heart were sound.

The head of the right thigh-bone was completely destroyed by caries.

Returning to a more minute examination of the liver and kidneys, it was found that over great part of the liver there was no appearance of lobules, but the gland seemed composed of an uniform greyish, compact, and in some degree transparent, substance; its cut surface looking not unlike that of firm bacon. In some parts near the edges of the liver the lobules were very conspicuous. They were enlarged, as in the fatty liver; and had yellow opaque margins, contrasting strongly with the central portions, which were greyish, compact, and somewhat transparent, as the entire substance of the liver was in its upper portion.

On a microscopic examination the grey compact portions were found to contain gland-cells, few in number, scattered amongst an abundance of a new unorganized deposit. The cells were of small size, more opaque and granular than usual, without any distinct appearance of nuclei or oil-globules. The new deposit appeared to occupy the meshes between the cells, which contrasted by their yellowish-brown colour and granular texture with the white and homogeneous appearance of the unorganized material infiltrated between them.

The liver was analyzed by Dr. Beale with the following result:

In 100 parts there were,

Water	80·150
Animal matter, with much albumen	16·098
Extractive matter, soluble in water	1·986
Fatty matter	·575
Alkaline salts	784
Earthy salts	407
	100·000

The tissues of the kidney were much degenerated. In many tubes the epithelium had a remarkably opaque and granular appearance. A few tubes contained an unorganized material like that in the liver; and in some parts this, when squeezed out, formed well-marked large 'waxy casts,' such as had been observed in the urine during life. The tubes which contained the waxy material had no epithelial lining, the secreting cells having been replaced by the new deposit. In other parts there was a very indistinct appearance of any structure, apparently in consequence of an infiltration of the same unorganized material into atrophied tubes; a condition which probably produced the granulations on the capsular surface.

The Malpighian bodies were white, opaque, and apparently bloodless; and the capillary walls much thickened. The arterial walls did not appear to be thickened.

The changes in the kidneys probably occurred in the order in which they have been described. Morbid materials were conveyed to them by the blood; in attempting to eliminate these, the secreting cells became changed, being in some parts replaced by an unorganized new material, which, together with the tubes, gradually wasted and became compact and hard. Meanwhile, as a consequence of this degeneration of the secreting cells, excretion was imperfect, and the circulation impeded; albumen escaped from the gorged Malpighian capillaries, and the walls of the vessels became opaque and thickened; finally, with the destruction of the tubes the circulation ceased, and the vessels shared in the general atrophy.

The disease in the liver and in the kidneys was evidently identical, and modified in its results only by the difference in the structure and function of the two organs. The deposit in the kidney was much less abundant than in the liver, although the functions of the former organ were more seriously interfered with by the disease than were those of the latter.

Another patient, who had been under the care of Mr. Partridge, and who died with scrofulous disease of the bones, had the same complication of renal and hepatic disease. In this patient, too, the waxy deposit was most abundant in the liver, and in both organs it appeared to take the place of the degenerated epithelial cells.

In several other instances which have come under my observation, the appearances in the urine have clearly shown that the kidneys were undergoing the same kind of waxy degeneration. The condition of the urine has for the most part corresponded with the following description, which it will be seen is very like that of the urine in the case of Woodman (p. 334). When first passed, the urine is clear and of a pale sherry colour; after standing some hours, it deposits a light cloudy sediment, in which are found a few large waxy casts entangling the small cells, or abortive germs of cells, which have been before described; some of the same cells, too, are often scattered over the field of the microscope. There is no renal epithelium, and rarely any blood-corpuscles. Sometimes there are a few of the casts which will be described hereafter, under the name of 'small waxy casts' (p. 352). The specific gravity of the urine varies considerably; it is sometimes low, as in the case of Woodman (No. 20); very commonly it is near the ordinary standard, and in one case, when the secretion was scanty, and the albumen very copious, the specific gravity ranged from 1024 to 1030. The quantity of urine secreted is usually below the standard of health, and the albumen is, in most cases, abundant. It will be seen, that in its colour, quantity, and density, and in the amount of albumen, the urine secreted by the kidneys in this state of chronic waxy degeneration differs from that of chronic desquamative nephritis, and approaches nearer to that state of urine which occurs in connexion with two forms of renal disease to be described hereafter.

There is one point in the minute morbid anatomy of this chronic form of waxy degeneration which is interesting, and to which I am anxious to direct attention more particularly than I have yet done. From the condition of the urine in the case of Hayden (No. 18), and particularly from the great number of waxy casts which it contained, it appears that when the disease is acute in its character, the waxy material becomes detached from the basement membrane, so that the casts are quickly ejected from the tubes, and, as I have before suggested, the apparently complete recovery of Hayden warrants the inference that the tubes, in such cases, regain their epithelial lining. On the contrary, when the disease is chronic, the morbid changes are much more slowly effected; the cells at first become, as it appears, opaque and granular, then they are gradually replaced by the waxy material, some of which escapes with the urine, and thus serves the purposes of diagnosis; but in the greater number of the tubes the material in question appears to adhere to, and to become blended with, the basement membrane, and subsequently the tube, with its imperfectly organized contents, wastes and contracts so as to form the firm granulations which appear on the surface of the kidney in connexion with the waxy deposit in the tubes. A portion of kidney in this last stage of degeneration presents no appearance of epithelial or tubular structure, and it is only by tracing the successive stages of the morbid process in the surrounding portions of the gland, that any definite notion can be obtained of the manner in which this wreck of organization has been effected.

This blending of the basement membrane with the effused material differs remarkably from that free casting off of the decayed epithelium which characterizes the process of simple chronic desquamation, and which leaves the basement membrane naked. The latter process, as already described, is favourable for the growth of the tubes into cysts, whereas the former is incompatible with that kind of development; and accordingly, when the waxy degeneration has been the primary disease, and not a secondary consequence of the desquamative process, we neither detect denuded tubes with the microscope, nor see cysts with the naked eye.

The waxy material is secreted only into the convoluted portions of the tubes, so that the medullary cones form a remarkable contrast, in their vascularity and their red colour, with the anæmic and pale waxy appearance of the cortical substance. The tubes in the medullary cones are, however, not entirely unaffected; it is scarcely possible that they should be, for some of the morbid products which are secreted into the convoluted tubes are occasionally arrested in their passage through the straight tubes. In some instances the epithelial lining of the straight tubes is more or less completely destroyed, and sometimes the basement membrane has a peculiar white glistening surface, which has been before referred to (p. 322 *note*), as causing a delusive appearance of great thickening of the wall of the tube. In some specimens there is an actual but slight thickening of the tubes; but the changes in the medullary cones are obviously of secondary importance, and the fact of the primary and essential morbid processes being confined to those portions of the tubes which alone have a glandular function, affords important confirmation of the doctrine that the changes in question are the result of a modified secretory action.

The waxy degeneration of the kidney has many points of agreement and alliance with the forms of disease which are to be described in the two succeeding chapters. I shall therefore reserve what I have to say on the diagnosis, prognosis, and treatment of waxy degeneration, until I have given the history of other pathological conditions with which this is intimately associated.

Chapter VI.

NON-DESQUAMATIVE DISEASE OF THE KIDNEY.

IN two previous chapters (III. and IV.) I have given the pathological history of a form of renal disease which is characterized by a desquamation of epithelium from the uriniferous tubes, the object of the desquamative process being, as I have endeavoured to prove, the elimination of some abnormal products from the blood. I have now to describe a form of disease, the most remarkable feature of which is the absence of that desquamation which is characteristic of the malady just referred to.

One of the best examples of the acute form of what I propose to call the *non-desquamative* disease, was afforded by the subject of the following case, which occurred in the Dreadnought Hospital.

I am indebted for the notes of the case, as well as for the opportunity of examining the kidneys and a specimen of the urine, to my very intelligent friend and former pupil, Dr. Henry Monckton, who was a resident in the Dreadnought when the case occurred, and consequently had the opportunity of watching the patient very constantly.

Case XXI.

Sudden appearance of general dropsy during convalescence from rheumatic fever.—Urine scanty and highly albuminous; no casts, epithelium, or blood. —Death in four days.—Inflammatory effusion into pleuræ and peritoneum, and engorgement of lungs.—Kidneys pale; epithelium opaque and granular.—No desquamation; Malpighian capillaries opaque.

John Ager, æt. 18, a seaman, was admitted into the Dreadnought Hospital on the 1st of January, 1850, with rheumatic fever.

In the month of March he was convalescent, taking tonics, walking about and reporting himself every day stronger and better. On the morning of the 15th of March, while he was still up and dressed, he first directed attention to his legs, which were much swollen, as was also the scrotum. He was ordered to bed and to keep all his water, which he said was scanty and high coloured. In the evening of the same day he was much worse, having been seized with urgent dyspnœa after eating a chop and making rather a sumptuous and rapid meal at tea time. The anasarcous swelling had much increased, and the abdomen was distended. He had passed no water. An emetic of sulphate of zinc was given, a mustard poultice to cardiac region, and as he was sitting on the edge of the bed, the feet were placed in hot water. He soon became much easier, and being propped up in the upright position, he fell asleep.

On the following morning, the 16th, the breathing was much easier, but small crepitation, sibilus, and rhonchus were heard over the lungs. The dropsy was less. The bowels had been freely opened ; motions watery ; urine passed in small quantity with them. ℞.—Potass. acet. ℥ss., Tinct. digitalis, ʒiss., Sp. ether. nit. ʒss., Tinct. scillæ, ʒii. ; Aquæ ad ℥xii. Sum. ℥iss, 4tis h.

Wine ʒiii. in 24 hours.

On the 17th he was much the same. The diuretic had little effect. In the night following he was seized with another fit of most urgent dyspnœa, so that life seemed instantly threatened. He was somewhat relieved by the same treatment as on the former occasion, but he could not sleep ; and on the following morning he was still much distressed. He could not speak, face pallid and pinched ; he was evidently weaker. Pulse 130. Loud wheezing sounds over the chest. Some urine was now obtained. It became almost solid with nitric acid, sp. gr. 1028.

℞.—Sp. ammon. arom. ʒss., M. camph. ℥i, 4tis h.

Wine and arrowroot.

March 19th.—Much less swelling of abdomen and scrotum, feet and ankles still much swollen. Has made no water since yesterday noon. Appears somewhat drowsy, and less sensible than usual. Countenance anxious and very pallid. Breathing somewhat easier, so that he can speak a little. Loud wheezing sounds over the chest Pulse very irregular and weak ; about 120. Resp. 48.

Empl. cantharidis on chest.

He gradually sank without any increase of dyspnœa, and died about 10 P.M.

INSPECTION, March 20th, sixteen hours after death.—Cellular tissue everywhere loaded with serum, face puffed, abdomen full.

Muscles of good colour and healthy aspect.

Pleuræ contained a considerable quantity of yellow serum, in which were masses of new, soft lymph, and in some parts the surfaces were united by recent lymph.

Lungs in many portions were in a questionable condition, approaching to solidification.

In the cellular tissue, about the bifurcation of the trachea, were two masses, about the size of blackbirds' eggs, apparently diseased lymphatic glands. When cut into, they were of a dark colour, and one contained pus.

Pericardium contained a small quantity of liquid.

Heart of moderate size; ventricles filled with coagulated blood; all the valves healthy.

Abdomen.—Cavity contained much serum, and flakes of lymph.

Kidneys.—Apparently healthy and of normal size. A portion of one was sent to me with some urine in a test-tube.

The *urine* was rather dark coloured, but nearly clear, and free from cloudiness. After standing it deposited some crystals of lithic acid, but contained *no casts, epithelium, or blood-corpuscles.* On adding nitric acid it became almost solid with albumen. The specific gravity, as before noted, was 1028.

The cortical substance of the kidneys was pale, with very little appearance of vascularity on the surface.

The tubes were abnormally opaque, and had a yellowish tinge, an appearance resulting from the condition of the epithelium, which was unusually opaque and granular—a departure from the natural condition very difficult to describe, though quite easily recognised. In a *very few tubes* there appeared to be a crowding of epithelium, the result of desquamation. No appearance of tubes containing blood. The Malpighian capillaries had the appearances so constantly observed when, during life, the serum of the blood has transuded through them. The coats of the vessels were opaque and apparently thickened, so that the blood-corpuscles within them appeared colourless and magnified. (See fig. 10, p. 101.) The changes in the Malpighian capillaries were evidently of quite recent origin; and there was not the slightest indication of any previous chronic disease in the kidney.

On the 17th of November, 1849, my friend, Mr. James Salter, brought me, from a patient who died in St. Thomas's Hospital, a portion of kidney which corresponded in every particular with the kidney of Ager. The only information I could obtain respecting the patient was, that he died with suppression of urine.

In the month of June of the same year, 1849, I observed precisely the same condition of kidney in the case of a boy, æt. 17, who died of cholera, after a few hours' illness, during which no urine was passed.

In this case, as in the two former ones, the tubes presented no evidence of the desquamative process; but the Malpighian capillaries had that opaque appearance before referred to, as a consequence of serous transudation through their walls.

These cases were the first by which my attention was particularly directed to that concurrence of phenomena observed in the case of Ager—viz., a very scanty secretion of highly albuminous urine, containing scarcely a trace of desquamated epithelium or of renal casts; urgent symptoms of suppressed secretion, often terminating fatally, and thus affording the opportunity of observing that there is nothing in the mere morbid anatomy of the kidney to explain the fatal consequences of the attack.

What, then, is the true explanation of the phenomena in question?

In order to arrive at this we must revert to the phenomena of acute desquamative nephritis.

I have endeavoured to prove that the abundant shedding of epithelium which characterizes that form of renal disease, is the result of a salutary effort to eliminate from the blood some abnormal products, the retention of which would, doubtless, be attended with injurious consequences, while their escape from the blood is probably favoured by the free shedding of the epithelial cells; as the elimination of the poison of scarlatina is effected by the desquamation which it excites on the surface of the skin.

A consideration of these phenomena suggests the probability that in the event of there being conveyed by the blood to the kidney, any of those abnormal materials which are usually eliminated by means of the desquamative process, the non-occurrence of desquamation would be an unfavourable circumstance. The absence of desquamation in such cases may be considered as analogous to those instances of the exanthemata in which the eruption is either entirely absent or very imperfectly developed; and this depending, not, as it appears, upon the blood being infected by a mild dose of the poison, but upon some failure in the effort to eliminate it by the eruption on the skin; the symptoms of blood-poisoning being, meanwhile, very urgent, and often rapidly fatal. Instances of such an occurrence may occasionally be seen in the case of small-pox; and it has frequently been observed, that the most rapidly fatal cases of cholera are those in which there has either been no purging, or only a very scanty secretion from the bowels; the patients quickly sinking either from an over-dose of the poison, or in consequence of some failure and imperfection in the effort to eliminate it.

With reference to these instances which have been adduced for illustration, it is important to distinguish between the essentially beneficial tendency of the primary morbid phenomena, and those secondary consequences which may be injurious, and even fatal. Thus in a former chapter (p. 111) I have alluded to the fact, that an abundant desquamation of epithelium may so fill and distend the uriniferous tubes as to arrest the process of secretion within them. A copious eruption of small-pox pustules may destroy the patient by the excessive irritation, and the exhausting discharges which they induce; and the excessive discharges produced by the cholera poison will so effectually drain off the watery portion of the blood as to destroy the life of the patient; and yet in each of the cases, consequences more speedy in their occurrence, and not less injurious, would result from the absence of those phenomena, which a superficial observer might erroneously consider to be the essence of the diseases referred to.

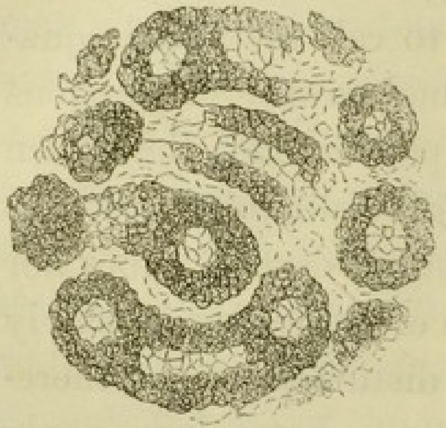
A careful study of these and other allied phenomena will show the importance of distinguishing the primary and essential cause of a disease from those outward and visible manifestations of it which are, in many instances, the means which nature adopts to remove the evil, or to obviate its injurious effects. The distinction is important—first, for the purposes of exact pathology, and secondly, as an essential condition for the correct and rational treatment of disease. It is evident, for instance, that the notion of scarlatina being primarily and essentially an inflammation of the skin would be a great error in pathology, and, applied to practice, would lead to serious and even fatal results. The cutaneous inflammation might be very speedily removed by the influence of cold, but injurious consequences would certainly result from the suppression of the eruption.

Before I had learnt to recognise and interpret the phenomena of what I propose to call the non-desquamative disease of the kidney, I had on several occasions based a favourable prognosis upon the idea that when the urine, though scanty and highly albuminous, is free from sediment, and contains neither casts of tubes nor renal epithelium, the condition of kidney is one merely of congestion or of functional disturbance, and therefore favourable for the patient's recovery. It was only after a lengthened period of careful observation, and after repeated disappointments and painful proofs that I had sometimes given a too-favourable prognosis, that I succeeded in separating the large proportion of error from the element of truth contained in the idea referred to.

The result of my inquiries, with reference to this matter, is, that a non-desquamative disease of the kidneys may occur, both in an acute and a chronic form.

The best example which has occurred to me, of the acute form of the disease, is the case of John Ager, whose history has already been given (p. 343). In that case, the urine contained neither renal epithelium nor casts of tubes, and the condition of the uriniferous tubes was equally indicative of the absence of desquamation. The epithelium had an unusually opaque appearance, but the central axis of the tubes was lighter than the margins (fig. 22); in this respect contrasting with such tubes as are filled by desquamated epithelium, in which the central parts, being of course thicker than the margins, appear more opaque when viewed with transmitted light (fig. 13, p. 209). An examination of the kidney alone, would enable a careful and practised observer to pronounce as to the presence or absence of desquamation; but the appearances in the urine, when they can be observed, are an important help in forming a diagnosis as to this point.

Fig. 22.



Sections of the tubes from a kidney in a state of non-desquamative disease. The epithelial lining of the tubes is opaque and granular, while the central canals are clear and open. Magnified 200 diameters.

From what has already been said, it will be apparent that the absence of desquamation is the characteristic feature of the condition of kidney now under consideration; and in some cases, as in that of Ager, the urine contains neither renal epithelium nor any form of tube-casts. The diagnosis of such cases, during life, must be based partly upon positive and partly upon negative evidence. To the first kind belongs the fact of a scanty secretion of highly albuminous urine, the specific gravity of which is low,*

* The specific gravity may not be absolutely low. In the case of Ager it was above the normal standard, the quantity of urine secreted being very scanty, and the albumen abundant. With the two last-mentioned conditions, the specific gravity may be high

and its colour nearly normal, or perhaps somewhat darker and less transparent than natural; while evidence of a negative kind is derived from the observation that the urine contains neither renal epithelium nor casts, nor, indeed, a sediment of any kind.

In certain cases, however, which I believe to be essentially of the same kind—as indicated by the absence of all signs of desquamation—the urine contains a peculiar form of cast, the observation of which will assist in the formation of a correct diagnosis. I believe that I shall best succeed in elucidating this point, by giving the history of the following characteristic case, with the addition of such remarks as are necessary to render it intelligible.

Case XXII.

General dropsy from intemperance and an insufficiency of nutritive food; an ecthymatous eruption over the body.—Urine highly albuminous, of low specific gravity, containing numerous 'small waxy casts' without epithelium.—Recovery.

George Henry Lewis, æt. 45, of intemperate habits; latterly had been much reduced in circumstances, and had consequently suffered from mental anxiety and an insufficiency of food. He was admitted into King's College Hospital under the care of Dr. Budd, on the 6th June, 1849. He was suffer-

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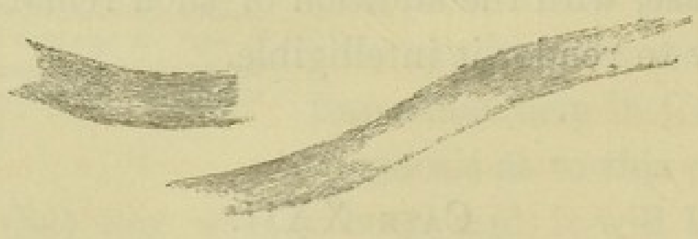
although the amount of solids discharged is much reduced. With reference to this point, compare the condition of the urine in cases of acute desquamative nephritis, p. 85.

ing from general anasarca and ascites in a very great degree, and his body was covered with an ecthymatous eruption. He was very pallid ; his breathing was difficult and accompanied by a wheezing sound. His condition was altogether very pitiable. The dropsy had appeared two weeks before his admission, and the eruption a month earlier. The sounds of the heart were normal. The urine was scanty, rather light coloured, somewhat cloudy, of specific gravity 1012, becoming almost solid with albumen when boiled. After standing, it deposited a pretty abundant whitish, dense precipitate, chiefly composed of *small transparent waxy casts, about one thousandth of an inch in diameter* (fig. 23). *Scarcely any epithelial cells were seen, and few if any blood-corpuscles.*

Fig. 23.



Small waxy casts.

He was first put on milk diet, and was ordered to have a tepid bath every morning, and to take small doses of solution of citrate of ammonia, with fifteen minims of ipecacuanha wine every six hours. He began to improve almost immediately. It may be well to mention here, that for several years he had been subject to epileptic fits, one of the consequences, probably, of his extreme intemperance, especially during his residence for six or seven years in the West Indies. During the continuance of the dropsy the fits returned with increased frequency, and he suffered much from headache. The urine was examined frequently, and its condition was carefully noted. The albumen continued very abundant for about six weeks. The quantity passed in twenty-four hours was not more than sixteen ounces when he was first admitted, but it soon became more abundant, and for some days it exceeded the normal quantity; on the 18th of June, for example, he passed eighty ounces, having a specific gravity 1012. The casts continued to have the same essential character as at the commencement; but after a time some of them had a fine granular appearance, a consequence, probably, of their having remained in the tubes until the material of which they were composed had become disintegrated. In some examinations there appeared a considerable number of blood-corpuscles, but on every occasion it was noted that there was 'scarcely any epithelium.'

On the 25th of June, it was first noted that some of the casts entangled a few oil-globules, and here and there appeared a cell containing oil. These appearances continued for about three weeks, and occasioned some anxiety lest the kidneys should undergo fatty degeneration; the more so, as the albumen was still very abundant.

About the middle of July it became evident that the oil was diminishing and the casts were less numerous; but the albumen was as copious as at the first. The average quantity was sixty-four ounces, and the specific gravity 1014; meanwhile he was improving in every respect. On the 26th of July, the albumen was reported to be much less, so that there was scarcely more than opalescence when the urine was boiled. The urine was clear; there was no sediment or cloud after standing, nor anything visible by the microscope. The eruption and the dropsy had entirely disappeared; his appetite and strength had returned, and the pallor of his face had been replaced by a healthy hue. Since the 26th of June, he had been taking steel, sometimes in the form of citrate, and occasionally in that of tincture of the sesquichloride.

July 30th.—He was progressing favourably, and had improved in every respect; the bowels were regular; the tongue clean, and he ate and slept well. The urine was *scarcely* albuminous.

On the 1st of August he left the hospital without permission, and has not since been heard of; the object of his sudden departure was, probably, to indulge his morbid appetite for intoxicating liquids, from which he could scarcely be restrained even while he was in the hospital. It would have been more satisfactory to have kept him under observation a few days longer, until the albumen had entirely disappeared; but the improvement had been so rapid and continuous, and the quantity of albumen at the last examination was so minute, that the case may fairly be considered a cure, although it is likely enough that he would soon again reduce himself to as bad a condition as he presented when he entered the hospital.

The most remarkable feature in the microscopic characters of the urine in the preceding case was the peculiar appearance of the casts, and particularly their small diameter as compared with the large waxy casts which have been observed in several of the cases before referred to. It is evident, that as the large waxy casts, which have the full diameter of the uriniferous tubes, must have been moulded in tubes which had no epithelial lining (see p. 185), so the *small waxy casts* which existed in the case of Lewis must have been formed in tubes which still retained their epithelium. The diameter of the casts—about $\frac{1}{1000}$ of an inch—was exactly equal to that of the canal existing in the centre of perfect tubes, the immediate boundary of the canal being the layer of epithelium which normally covers the inner surface of the basement membrane. (See fig. 5, p. 28.) It is evident, then, that the appearance of the small waxy casts indicates that the tubes in which they have been moulded still retain their epithelial lining; and, relying upon this favourable indication, I ventured to suggest to Dr. Budd, at the time when Lewis first came under our observation, that his patient would probably recover. My prediction was happily verified by the result; but I have since discovered that one opinion which I then entertained, and upon which my favourable prognosis in that case was partly based, was, in fact, an erroneous one. The mistaken opinion to which I refer I have thus expressed when commenting upon the case of Lewis, as published in the *London Journal of Medicine* (February, 1851):—'The almost entire absence of epithelial cells from the urine showed that the secreting structures were but little involved; *since any morbid matter in the blood, injuriously affecting the secreting cells, would have led to a desquamation of these structures.* The inference was, that the blood was in such a morbid state as produced congestion of the Malpighian capillaries, while it affected but slightly, if at all, the secreting cells of the kidney.'

It is only since the publication of these remarks that I have discovered the error contained in the statement which I have here printed in italics. I have been enabled to correct that error by the observation of cases which have occurred within the last year, and by a comparison of these with the histories of cases which I had seen previously, and which I could not at the time completely and satisfactorily explain. A reference to the history of Lewis will show that the great degree of dropsy, the increased frequency of his epileptic fits, and the other consequences of suppressed renal secretion, cannot be explained on the supposition of simple congestion of the Malpighian capillaries. And again, the low specific gravity of the urine, which would have been still further reduced by the removal of the albumen—while the quantity did not exceed sixteen ounces in twenty-four hours, —affords decisive evidence of such a deficient excretion as can be accounted for only by a greatly impeded action of the secreting cells. Further, the history of Ager's case proves that a very scanty secretion of urine, attended with rapidly fatal consequences, may be associated with only such a degree of change in the appearance of the secreting cells as suffices to show that they are implicated in the disease, although there may have been no desquamation or shedding of epithelium.

A comparison of these cases with those of acute desquamative nephritis, leads to the conclusion that the free shedding of epithelium is an efficient means of eliminating abnormal and noxious products; and further, it shows the probability that if, in the case of Ager, there had been a free desquamation, the disease might have terminated favourably, and that in the case of Lewis a similar process might have shortened the duration and lessened the severity of the attack.

With reference to the source and cause of the casts in the urine of Lewis, I would suggest the following explanation as being probably correct. The blood conveyed to the kidney contained some excrementitious materials different from the normal urinary constituents, and of such a kind as did not excite the ordinary process of desquamation by which they might have been more effectually eliminated. The blood, therefore, being slowly and imperfectly purified, was retarded in its passage through the intertubular capillaries in accordance with the principles before referred to (p. 236 *et seq.*) The Malpighian capillaries then became gorged, and consequently there transuded through their walls, together with the serum of the blood, some fibrinous materials, which coagulated in the tubes, and thus formed the small waxy casts which were observed in the urine. The escape of these materials from the Malpighian capillaries, was doubtless a means of relieving the over-distension of the vessels, and it is not improbable that the fibrinous transudation in the case of Lewis was a more effectual relief to the circulation than the escape of serum alone would have been. If I am right in this conjecture, the presence of the small waxy casts in cases of non-desquamative disease may be considered as a favourable indication, and one which justifies a more hopeful prognosis than when, as in the case of Ager, there are no such appearances in the urine. The appearance of blood-casts in the urine in the same circumstances is, I believe, a sign of favourable import, inasmuch as hæmorrhage from the Malpighian vessels affords greater relief to the circulation than the escape of any constituents of the blood short of actual hæmorrhage.* And this relief of the over-distended vessels appears to be more than sufficient to compensate for any impediment to the secretory functions which may result from some of

* See the remarks upon this point, with reference to waxy degeneration, and the case of Hayden, p. 328 and 9.

the tubes being temporarily filled with coagulated blood or fibrin. When describing the microscopic characters of the urine in acute desquamative nephritis, I stated (p. 90) that some of the small waxy casts are frequently present. The explanation of their appearance in such instances is the same as when they occur alone in cases of non-desquamative disease. Fibrinous materials escape from the over-distended Malpighian capillaries, and these, after coagulating in some tubes, whose canals have not been filled by desquamated epithelium, are washed out, and thus form the casts in question.

The cases of non-desquamative disease to which I have hitherto alluded were of an acute character; but I have now to give the history of the same disease as it occurs in a chronic form, and to indicate the relations which it has with some of the forms of disease which have already been described, as well as with the fatty degeneration which will form the subject of the following chapter. The condition of urine which indicates the existence of the chronic non-desquamative disease is commonly as follows. When first passed it is clear, and either of the natural colour, or somewhat paler than ordinary. After standing, it deposits no sediment, or merely a slight cloud, composed of pavement epithelium from the bladder. The quantity of urine secreted daily is generally less than normal, and is often much below the standard of health.

The specific gravity varies considerably; it is seldom very low, and frequently it is up to, or even above, the healthy standard; but the daily discharge of solids by the kidneys is almost constantly below the normal amount. The quantity of albumen varies according to the intensity of the disease, but in a large proportion of cases it is very abundant, so that the urine when boiled becomes almost solid. It has usually an acid reaction. On a microscopic examination, the urine is found to contain neither casts of tubes nor renal epithelium. In some cases scattered blood-corpuscles may be present, but this is not common, and a copious sediment of blood, either in the form of blood-casts or otherwise, is still more rare. Crystals of the triple phosphate or of lithic acid may sometimes be seen; but their presence is accidental and by no means common or essential. I have said that the urine contains no casts of tubes. I have found this to be the case in several instances of the disease which have come under my notice. And this has been the result of the examination of specimens of urine from the same patient at different intervals extending over a period of several weeks or months. It frequently happens, however, that a careful examination detects some of the small waxy casts which have been described as existing in the urine of Lewis. These may be found on the occasion of one examination, and after an interval of a week or two they may not be present; but again, on a third examination, they may be detected in variable numbers, forming a slight cloudy sediment. They are, however, rarely, if ever, abundant when the disease has been of long duration.

The general symptoms which accompany the disease are usually serious in kind and degree. The blood becomes much impoverished by the copious drain of albumen, at the same time that it is poisoned by retained excrement. The dropsy, which is present in the advanced stages of almost every case, is often excessive, and very little influenced by any kind of medical treatment. Symptoms referable to the nervous centres, coma and convulsions, congestion and inflammation of the lungs or the serous membranes, are amongst those accidents of the disease which are frequently fatal. The appearances presented by the kidneys are well represented in Dr. Bright's plates (2 & 4*), less faithfully by M. Rayer in his illustrations of what he calls the second and third forms of albuminous nephritis, which are, in fact, different stages of the disease we are now considering.

The kidneys usually present an increase of size and weight, and as they are firmer and denser than in the normal state, their increase of weight is greater than that of their bulk. It is not unusual to find the weight of each kidney as high as from six to ten ounces, but it varies in different cases, according to the extent and duration of the disease, ranging between the normal standard and the extreme weight last mentioned.

The appearances of the kidney which are amongst

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* Figs. 1 & 2 in the second plate represent the earlier stage, while fig. 4 in the same plate, and figs. 1 & 2 in plate 4, represent a more advanced stage of the disease.

the most constant and characteristic, are a gradually increasing wax-like pallor of the cortical substance, and a loss of the colour which depends on its vascularity, while the medullary cones retain their vascularity, and have a pale pinkish colour. As the disease progresses, the lobular markings gradually become obliterated over a large portion of the capsular surface, until at length there remain only a few small, isolated, vascular patches, as represented in Dr. Bright's fourth plate.

In a comparatively small number of instances, hæmorrhagic spots are scattered over the surface, or in the substance of the cortical portion. The capsule may be readily removed, so as to leave a smooth, ungranulated surface; the only inequalities being slight bulgings of those parts of the cortical substance which correspond with the original divisions of the gland into lobes (see p. 11). When an attempt is made to inject the kidney, it is found that many of the vessels are nearly or quite impervious, so that very little injection can be thrown into them. Some divisions of the renal vein are very commonly filled and obstructed with firm coagula.

On a microscopic examination, the greater number of the convoluted tubes present no other change than that of being more opaque than usual, in consequence of an opaque granular appearance, and occasionally a brownish-yellow colour of their epithelial lining.* The

* Dr. Gairdner has described this condition of kidney under the name of 'waxy degeneration.' He says, 'The microscopic cha-

epithelial cells appear to contain an unusual quantity of solid matter. The central axis of the tubes is lighter than the margins (fig. 22, p. 350), and presents a free canal, which is not filled with epithelium, as in cases of desquamative disease. The central canal may sometimes be found filled with the white coagulable material which forms the small waxy casts. In those comparatively rare instances, before mentioned, of hæmorrhagic spots appearing in the cortical substance, some of the tubes may be seen filled with blood.

The straight tubes of the medullary cones usually present no important change of structure.

The condition of the bloodvessels does not differ essentially from that which I have described in connexion with the chronic desquamative disease (chap. iv). The *Malpighian capillaries* pass through a regular series of changes, from simple engorgement with blood, which appears of a red colour through the unthickened capillary walls, to a gradually increasing thickening and opacity of the vessels, as a result of which they finally

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racters of this lesion are chiefly negative. There is not unfrequently an entire absence of exudation; indeed, in the most marked cases of the lesion, I have seldom found even the slightest trace of any abnormal deposit. Occasionally, however, there is a very minute quantity of fatty exudation in the tubes, generally in very small granules, and scattered throughout the organ.' He considers that the disease consists in an obliteration or obstruction of the capillary system of vessels throughout the organ, and a partial obliteration of the veins on its surface (*loc. cit.*, pp. 34 & 35). It will be seen that this description of the morbid anatomy of the disease is nearly in accordance with my own observations.

assume the appearance of firm, whitish, waxy coils. In this condition, though they appear perfectly exsanguine, the addition of acetic acid frequently renders the vessels transparent, and shows a single row of blood-corpuscles within them; the canal of the vessel appearing to be narrowed, while the wall is thickened. In some of the Malpighian tufts there is no appearance of blood-corpuscles after the addition of acetic acid; the circulation through them appears to have entirely ceased, and, as a consequence of this, the capsule and the tuft are sometimes shrunk and atrophied, while, in other instances, oil-globules are collected within and upon the vessels. The two last-mentioned results—the collapse of the Malpighian bodies, and a deposit of oil within them—are less frequently associated with the form of disease now under consideration, than with the chronic desquamative disease.

The muscular coats of the *arteries* frequently present the appearances of hypertrophy, which I have before described in connexion with the chronic desquamative disease. This, however, is less constantly associated with the non-desquamative than with the desquamative form of disease; and, so far as I have observed, the hypertrophy of the arteries appears to bear a direct proportion to the duration of the disease, and an inverse proportion to the general enlargement of the kidney. I shall presently suggest an explanation of these relations.

The examination of the *inter-tubular capillaries* gives, for the most part, the same negative result as in the cases of chronic desquamative nephritis, which have been before referred to (p. 235). They can rarely be injected, and when visible at all, their coats appear unthickened, and thus in remarkable contrast with the opaque and thickened Malpighian capillaries. It appears that a large proportion of these vessels are obliterated and atrophied, the circulation through them having ceased.

The atrophy and obliteration of the minute branches of the *veins* are shown by the more or less complete disappearance of the hexagonal lobular divisions on the capsular surface, as a result of which, the renal tissue becomes pale and exsanguine. A microscopic examination detects no appearance of thickening or hypertrophy of the coats. Some of the larger divisions of the veins, as already mentioned, are occasionally plugged with firm coagula of blood.

I have hitherto given no explanation of the increased size and weight of the kidney. I believe that these are, in many cases, the result of a simple hypertrophy of the glandular tissues, similar to that which occurs when, from some accidental cause, one kidney has to do the work of both, and when, in the discharge of its double function, it acquires a corresponding increase of size and weight. It is assumed, with a great degree of probability, and for reasons which have before been referred to, that the proximate cause of the disease in question is the admixture with the blood of some new materials, which, not finding a free outlet by the ordinary process of renal desquamation, tend to embarrass the circulation through the kidney, and also to accumulate in the blood, together with some of the normal constituents of the urine, whose elimination would of necessity be retarded simultaneously with that of the morbid materials with which they are associated. This accumulation of excrementitious materials in the blood will act as a stimulus to the increased growth and development of glandular tissue; for the tissues in question may be said to feed upon the materials for which they have an affinity, and the growth of a gland is in proportion to the quantity of its proper secretion with which it is supplied by the blood. This appears to be the physiological explanation of the double size of a kidney which has to discharge the functions of two glands, as well as of the increased bulk of the kidneys, which occurs when their secreted products are modified by the admixture of some morbid materials which are very difficult of elimination.

It is a point of some interest to ascertain what is the precise mode in which the bulk of glandular tissue is increased in the cases referred to; whether by the development of new tubes and Malpighian bodies, or by an increase in the diameter of those which already exist, or by their growing to a greater length, and having an increased number of convolutions.

There is no reason to suppose that new tubes are formed; nor does it appear that an increased diameter of the tubes is a common occurrence. One impediment to the last-mentioned change in the tubes is the existence of the fibrous meshes of the matrix in which the tubes are enclosed, and by which they are constricted, when, from any cause, the tubes are distended and dilated. That this actually occurs in cases of non-desquamative disease, is, I think, nearly certain. The epithelium appears to grow more bulky, so as to expand the tubes, which consequently become firmly impacted in the meshes of the matrix; and this seems to be one cause of the increased firmness of the kidney, which is commonly observed in these cases; it will also partly explain the impeded inter-tubular circulation. The enlargement of the kidney is, however, insufficiently accounted for by any increase in the diameter of the tubes, and it is in the highest degree probable, that there is an actual increase in their length, and in the number of their convolutions. It is, of course, quite impossible to dissect out a tube so as to measure its normal length, or the increase which results from hypertrophy. The point in question can be determined only by the method of exclusion—by ascertaining that there is no other observable condition adequate to the production of the existing enlargement of the kidney.

There remains to be mentioned an important difference between the hypertrophy of the renal glandular tissue, consequent upon one kidney having to discharge the functions of both—the blood meanwhile containing none but its normal constituents—and those instances of hypertrophy which result from the ordinary constituents of the renal secretion being associated with certain abnormal products, whose elimination is continually attended with more or less of difficulty. In the first-mentioned instances of hypertrophy, although a temporary embarrassment of circulation and secretion may be occasioned by the sudden assumption of a double function by one kidney, yet, in process of time, the growth of glandular tissue enables the kidney to perform its extra work with ease and efficiency. The increase in the quantity of renal excrement to be discharged by the single kidney does not, in these cases, exceed a certain definite amount—it is exactly doubled—and this increase of secretory labour is provided for by a corresponding increase of glandular tissue. But in the instances of enlargement of the kidney resulting, not simply from the secretion of a double amount of the normal urinary constituents, but from a continued effort to eliminate some new and morbid products, the development of glandular tissue appears to be unequal to the demands which are being made upon it. These abnormal materials, whose tardy and difficult elimination have been the original cause of mischief, are constantly present in the blood, and add indefinitely to the strain upon the kidney.

The circulation through the inter-tubular capillaries is retarded in a manner which I can explain only by a reference to the slow and incomplete manner in which the gland-cells discharge their functions, and the consequent retention of excrementitious materials in the blood.* The serum of the blood is continually poured from the gorged Malpighian capillaries, and the bloodvessels themselves gradually undergo that series of pathological changes which I have already described, until at length a large proportion of the

* See the explanation given of the proximate cause of albuminous urine, p. 236 *et seq.*

cortical substance of the kidney assumes a pale, waxy, exsanguine appearance. Meanwhile the poisonous excrements, as well the normal as the abnormal constituents, accumulate in the blood, and exert a noxious, and often a fatal, influence upon various parts of the body.

It will be understood, from what has already been said, that hypertrophy of the secreting tissue is not a *constant* effect of the non-desquamative disease. The conditions which appear to be necessary for such a result are, a moderate degree of morbid alteration of the blood, and such a duration of the disease as may suffice for the growth of new tissue.

Thus in a case like that of Ager, which proved fatal in a few days, there could be no increase of secreting tissue. And in other cases, when, in consequence, probably, of a very morbid condition of the blood, the renal circulation is much retarded, as shown by the highly albuminous condition of the urine, and by the thickening and obliteration of the bloodvessels observed after death, not only may hypertrophy be entirely absent, but the volume and weight of the kidneys may be actually less than normal. The waste of tissue, in such instances, appears to be a consequence of the circulation being greatly impeded, and at length, perhaps, actually arrested in many parts of the gland.

A considerable diminution of the size and weight of the kidney is, however, a very rare occurrence as a consequence of the non-desquamative disease; and this forms one of the most remarkable points of difference between this condition of kidney and the chronic desquamative disease, atrophy being the rule in the latter case, and a rare exception in the former. So long as the gland-cells retain their position—as in the non-desquamative disease—the size of the kidney, if not increased, is seldom diminished; but the disintegration of the epithelium, and the consequent appearance of granular casts in the urine, is almost invariably associated with more or less of atrophy. And here it may not be out of place to remark, that the process, which I before described (chap. iv. p. 209) as one of disintegration of the epithelium, without the occurrence of that desquamation which leaves the tubes denuded, appears to be, as it were, intermediate between the desquamative and the non-desquamative condition of the kidney. The merely disintegrative process resembles the chronic desquamative disease in causing the appearance of 'granular casts' (p. 178) in the urine, but it differs from the latter in not leaving the tubes denuded; while the non-desquamative disease is neither attended with the appearance of granular casts, nor does it deprive the tubes of their epithelial lining.

The cases of non-desquamative disease in which the hypertrophy of the gland attains its greatest degree are those in which the changes occur very gradually, so that the growth of secreting tissue nearly keeps pace with the extra work imposed upon it, and is only just insufficient for the complete elimination of the excrementitious materials contained in the blood. A very good illustration of this fact is afforded by the following case.

Case XXIII.

Slight general dropsy; ascites in an extreme degree. Urine scanty, of moderate specific gravity, albuminous, and tinged with blood.—Liver in an advanced stage of cirrhosis.—Kidney enlarged from non-desquamative disease, with hypertrophy.

George Pow, æt. 19, was admitted into King's College Hospital, under the care of Dr. Budd, at the beginning of October, 1851. He had led a very intemperate life, and at the time of his admission he was suffering from ascites consequent upon cirrhosis of the liver. He was weak and pallid; the conjunctivæ yellow; the superficial abdominal veins dilated; the liver could not be felt.

The urine was rather scanty, being on an average twenty-six ounces in the twenty-four hours; it was moderately albuminous, and frequently tinged with blood, much of which was in the form of tube-casts, specific gravity 1017; no renal epithelium was observed in the urine.

Soon after his admission he began to improve, but subsequently he appeared to be losing strength, and towards the end of October, it was first noted that his ankles were a little swollen. The swelling gradually increased, extended up the legs, and affected the scrotum, but the ascites was always the most prominent and distressing dropsical symptom. Meanwhile he suffered much from dyspnœa, which gradually became more distressing, until at length he died rather suddenly on the 27th of November. The urine had continued in the condition before described, the blood tint rather diminishing. The average specific gravity was 1015. On the day before his death the quantity amounted to 26 ounces.

Inspection.—The abdomen contained a large quantity of serous liquid. The liver was very small, contracted, and granular—a marked specimen of 'gin-drinker's liver.' The spleen was much enlarged. The kidneys were of equal size; one weighed $7\frac{1}{4}$ ounces. The heart was of natural size; all its valves were healthy, except a small deposit of fibrine on the convex edge of one aortic valve.

Returning to the kidneys—it was noted that their increase of size was in proportion to that of their weight. Their surface was smooth and pale, but with many small hæmorrhagic spots scattered over it.

In most parts of the surface the hexagonal venous markings remained distinct. The general appearance of the kidney was not unlike that represented in the third and fourth figures of Rayer's 7th Plate, but the increase of size and the decrease of vascularity were less than in Rayer's case.

On a microscopic examination the hæmorrhagic spots were, as usual, found to consist of tubes filled with effused blood. The epithelium in the convoluted tubes differed from its normal appearance only in being somewhat more opaque and granular. There was no evidence of desquamation or of other morbid change, except in the few tubes which contained blood. The Malpighian capillaries presented the appearances of slight opacity and thickening, which are usually observed where there has been a moderate amount of impediment to the renal circulation. There was no evidence of hypertrophy of the arterial tissues.

In this case it would be difficult to ascertain at what time the enlargement of the kidney commenced. It is probable, however, that it had gradually increased during a period of several months before the fatal termination of the case, and it is little less than certain that it was the result of a beneficial effort to eliminate from the blood some of the noxious excrement with which the gin-drinking habits of the patient were infecting it.

The albumen which escaped from the Malpighian vessels was evidence that the growth of secreting tissue was unequal to the demands made upon it; the circulation was therefore impeded, and blood, as well as albumen, escaped from the gorged vessels which had not undergone the degree of thickening that would secure them against rupture.

A consideration of the facts and arguments which have been adduced, will at once suggest an explanation of the statement, which I have before made, that there appears to be an inverse proportion between the general enlargement of the kidney and the thickening of the arteries and Malpighian capillaries; since it is evident that, *cæteris paribus*, the strain and pressure upon the vessels, and the consequent thickening of their walls, will bear an inverse proportion to the amount of efficient secreting tissues; and this remark is applicable as well to the cases of chronic desquamative disease as to the form of disease which we are now considering.

It is obvious that, in some cases, the increased size and weight of the kidney are partly caused by certain pathological changes which are associated with the hypertrophy of glandular tissue; I allude to the effusion of fibrin or blood into the cavities of the tubes, and to the thickened state of the arteries and Malpighian capillaries. These conditions must, in proportion to the degree in which they exist, increase the density of the kidney; but they can scarcely add much to the general bulk of the gland, and in many instances, as in the case of Pow, they are present in only a slight degree, while the size and weight of the kidney are increased in a much greater proportion. An explanation of the apparently inverse proportion between the size of the kidney and the thickening of the bloodvessels has already been suggested.

I shall speak of the diagnosis, prognosis, and treatment of the non-desquamative form of disease at the conclusion of the next chapter, when I have given the history of fatty degeneration of the kidney.

It may be well to indicate in this place the kind of relation which the non-desquamative disease sometimes has to acute desquamative nephritis. I have observed very distinctly in one instance, that a chronic non-desquamative condition of kidney has supervened upon an attack of acute desquamative nephritis.

A boy 14 years of age had an attack of acute desquamative disease, with dropsy, and the usual microscopic and chemical characters of the urine, in March, 1851. The disease appeared to have been excited by exposure to cold and wet, with insufficient clothing. The urgent symptoms soon subsided, and the urine became normal in colour, quantity, and density; but the albumen did not entirely disappear, nor has it done so at the present time (April, 1852). I have frequently examined the urine, the colour of which is nearly normal; its sp. gr. is usually about 1020, quantity natural, moderately coagulable by heat and nitric acid. After standing, it deposits a slight cloudy sediment, containing a few small waxy casts, with occasionally a few blood-corpuscles, but scarcely a particle of renal epithelium.

The boy has grown rapidly during the last year; he has no trace of dropsy, and his general appearance is that of good health.

I believe that, as yet, there is little structural change in the kidneys, and probably none which is not quite remediable.

The boy's parents, acting upon my advice, are endeavouring to make arrangements for sending him to sea during the present summer.

If they succeed in doing this, there is, I think, much reason to hope that he may return in perfect health. A few weeks since, after a month's residence in the country, the albumen had nearly disappeared, but it increased again after his return to London.

It is highly probable that the sequence of events which occurred in the preceding instance is not uncommon, and the possibility of such an occurrence is an additional reason for extreme care in the management of patients during the convalescence from acute desquamative disease, whether in connexion with scarlatina, or in what circumstances soever the renal disease may have arisen. A patient is not free from the danger of confirmed chronic disease, so long as any albumen remains in the urine after an acute attack.

I have lately met with a remarkable instance of the long continuance of albumen in the urine after acute renal disease occurring in connexion with scarlatina.

A medical practitioner, now 33 years of age, had scarlatina sixteen years ago. At an early period of the disease he was exposed to cold, and the result was an attack of renal dropsy.

The disease soon subsided, he regained his strength, and thought no more of his malady until the year 1841—about five years after the attack of scarlatina—when one of his fellow students happened to examine his urine, and found it to be albuminous. From that time he has closely watched the urine, and has never found it free from albumen. In quantity, colour, and density, it is usually normal. The specimen which he brought to me had the usual sherry colour, sp. gr. 1020, slightly but decidedly coagulable by both heat and nitric acid. After standing it deposited neither sediment nor cloud, and neither casts of tubes nor renal epithelium could be detected by a microscopic examination.

He is actively engaged in London practice, is well nourished, and has the appearance of good health. I believe that even Dr. Bright himself, without knowing his previous history, would not suspect him of having albuminous urine; yet his urine has been constantly albuminous for eleven years, and probably, as he himself believes, it has not been free from albumen since the attack of scarlatina sixteen years ago.

This case is interesting and encouraging, as showing for how great a length of time the urine may continue to be albuminous without the occurrence of any serious structural change in the kidney. It is probable that, at the present time, the only change which the kidneys have undergone is a degree of enlargement from hypertrophy, with, perhaps, some opacity and thickening of the Malpighian capillaries and of the arteries.

In the next chapter I shall indicate the relations which this chronic non-desquamative disease occasionally has to some of the more serious forms of renal degeneration.

Chapter VII.

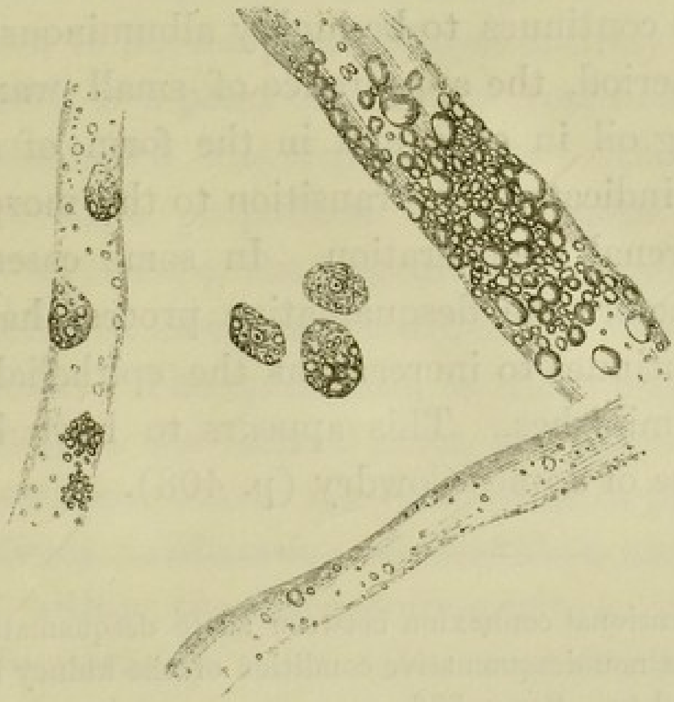
FATTY DEGENERATION OF THE KIDNEY.

SECTION I.—GRANULAR FAT KIDNEY.

THE pathological changes which I have described as being characteristic of the chronic non-desquamative disease are, in a large proportion of cases, unassociated with any other morbid appearances in the kidney. In a number of instances, however, more or less of fatty degeneration of the renal tissues is found to co-exist with the appearances which are characteristic of the disease which I have just now described. It is a matter of considerable interest to ascertain the relations which the two forms of disease bear to each other. A solution of this question is to be sought for, first, by a careful examination of the urine, repeated at intervals during the progress of the disease; and, secondly, by an inspection of the pathological appearances presented by the kidneys after death. Each mode of investigation has its peculiar advantages, and both lead to the conclusion that fatty degeneration of the kidney is, at least in some cases, one of the consequences of that non-desquamative form of disease whose history I have before given.

The appearances in the urine which indicate the relation and the sequence to which I have referred, are, a continuance, for a longer or shorter time, of those conditions which have already been described as characteristic of the non-desquamative disease—viz., a rather scanty secretion of highly albuminous urine, of moderate specific gravity, of nearly the natural colour, usually clear and free from sediment, and containing neither renal epithelium nor casts of the tubes, or if any of the latter, only those small waxy casts which were observed in the urine of Lewis. After a period, which is very variable in different cases, while the general characters of the urine remain the same, there appears a light cloudy sediment, which is usually found to contain some of the small waxy casts, in which are entangled one or more globular or oval cells, enclosing a variable number of oil-globules (fig. 24); some of the cells being completely filled

Fig. 24.



Oily casts and cells.

with oil, and presenting the appearance of dark opaque masses. Some of the casts have adhering to their surface a variable number of scattered oil-globules, which have probably escaped from ruptured cells. Some oil-containing cells and detached oil-globules are also scattered over the field of the microscope. I have already suggested an explanation of the small waxy casts. Their number is very variable at different periods during the progress of the same case. Occasionally they are absent for a time, and usually reappear when, from exposure to cold, or from any other cause, the renal congestion has been aggravated.

I have before stated (p. 91) that fatty degeneration is an occasional consequence of acute desquamative inflammation of the kidney. I believe that when this happens, an intermediate non-desquamative condition usually occurs before the fatty degeneration.* The epithelial desquamation ceases, the urine becomes clear, but continues to be highly albuminous; and at a later period, the appearance of small waxy casts, entangling oil in cells, and in the form of scattered globules, indicates the transition to the more serious form of renal degeneration. In some cases the oil appears before the desquamative process has ceased, and it continues to increase as the epithelial desquamation diminishes. This appears to have happened in the case of James Cowdry (p. 408).

* The occasional connexion between acute desquamative inflammation and a non-desquamative condition of the kidney has already been adverted to. See p. 373.

When the disease has terminated fatally, as it too commonly does, the kidneys usually present the appearances which are represented in the third figure of Dr. Bright's 3rd plate; also in the 8th plate of Rayer, in which he has given illustrations of what he calls the fourth form of albuminous nephritis.

The general characters of the kidneys as to their increased size and weight, their smooth surface, and the pale, non-vascular appearance of their cortical portions, are exactly similar to those which have already been described in connexion with the chronic non-desquamative disease. But in the cases now under consideration, there is the addition of certain characteristic granulations of a yellowish-white colour, which are scattered through the cortical substance. These opaque granulations, which have a general resemblance to the so-called atheromatous patches in arteries, are found, on a microscopic and chemical examination, to be composed almost entirely of fatty matter; and it is a point of much interest to ascertain the relations which this deposit bears to the normal tissues. A large proportion of the tubes present, under the microscope, the appearances which I have already described as characteristic of the non-desquamative disease. The epithelium is more opaque and granular than in the natural state, and perhaps occupies a larger space within the tube, so as to produce a slight tendency to dilatation of the tubes, and a close impaction within the surrounding rings of fibrous tissue. Occasionally some tubes contain the white wax-like material in the canal surrounded by the epithelial layer, and in other instances some tubes are filled with blood; in which case, hæmorrhagic spots in the cortical substance are visible by the naked eye.

The incipient tendency to fatty degeneration is shown by the appearance of oil-globules within the epithelial cells of some of the tubes. It is not unusual to see in the epithelium of a kidney, which there is reason to suppose nearly or quite healthy, one or more minute oil-globules; but when fatty degeneration is commencing, these oil-globules increase in number, and form clusters, until at length they completely fill the cell. The epithelial cells of those tubes which are yet in the early stage of fatty degeneration, retain their normal shape and position, forming a single layer on the surface of the basement membrane. As the degeneration advances, the cells assume an entirely different form and appearance; they lose their irregular angular outline, and appear globular or oval, with homogeneous transparent walls; but when completely filled, as they often are, with small oil-globules, they appear opaque and dark. They have now entirely lost their epithelial character, and cannot be distinguished from the granular cells which are commonly seen in scrofulous or cancerous tumours. One of the yellow granulations, before mentioned, when placed under the microscope, is seen to contain these cells in great numbers. A thin section carefully made with a Valentin's knife, often shows a considerable length of convoluted tube completely filled and blackened with the opaque granular cells; so that as the hæmorraghic spots in the cortical substance are composed of convoluted tubes containing blood, the yellow granulations consist of tubes distended with oil. In many of the granulations it is difficult, and sometimes impossible, to trace the continuity of the tubes, they appear to have been ruptured by over-distension, or perhaps they have suffered from atrophy, which appears to be a necessary consequence of the degeneration of the epithelial cells, and the substitution of the granular oil-containing cells for the normal contents of the tubes; or it may be that the degeneration of the cells and the atrophy of the tubes are results of one common cause—viz., the impeded capillary circulation which precedes and accompanies the disease in question.

With reference to this last suggested cause of the phenomena, it is not without interest to remark, that there appears to be an analogy between these small spots of renal degeneration, and those larger patches of degeneration of the muscular substance of the heart which are associated with a more or less impervious condition of the branches of the coronary artery distributed to the diseased parts.* Upon this view of the subject it would appear that as the spots of renal degeneration are a consequence of obstructed circulation, so they afford a kind of evidence of the actual existence of an impediment to the circulation; evidence, however, which is not needed, since the im-

* With regard to this point, I cannot do better than refer to that section of Dr. Quain's excellent paper, in which he treats of fatty degeneration of the heart 'connected chiefly with local modifications of nutrition,' *Med.-Chir. Trans.* vol. xxxiii. p. 147.

peded state of the inter-tubular circulation has already been proved (chap. iv.)

It frequently happens that the tubes being ruptured by the knife, or other instruments used in preparing the section for examination, the oil-globules become irregularly scattered over the specimen, and they often adhere to the fibrous rings of the matrix, so as to give the appearance of this tissue being the actual seat of the fatty deposit or degeneration. I believe that the inter-tubular capillaries sometimes contain oil. I have little doubt, however, that the appearance of a fatty deposit in the fibrous tissue of the matrix is delusive and explicable, as I have just now suggested, by the bursting of the tubes, and the consequent escape and dispersion of the oil. I have invariably noticed that while the tubes remain entire, however abundant may be the oil within them, the inter-tubular tissue is free from the deposit; and that the oil which sometimes adheres to the matrix, after the bursting of the tubes, may, without much difficulty, be removed by briskly agitating the specimen in water. Both these facts are opposed to the notion of fatty degeneration of the fibrous tissue, which, if it ever happen, is a rare and exceptional occurrence.

In some specimens, oil-globules may be seen in the Malpighian capillaries, but this occurs much less frequently in the cases now under consideration than in cases of chronic desquamative disease. The same caution is required with regard to this point as to an appearance of oil in the inter-tubular tissue. When oil-globules are scattered over the specimen they often appear to be contained in the Malpighian capsules. To ascertain if they actually are so, the specimen must be carefully washed, and the Malpighian bodies should be examined in parts where the tissues are least broken and disturbed.

That the material which forms the yellow granulations is of a fatty or oily nature is proved—1st, by the peculiar and characteristic appearance of the globules when examined by the microscope; and 2ndly, by the fact, that the granulations as seen by the naked eye, and the globules visible by the microscope, are entirely removed by digestion in ether. When the fatty matter is in the form of very minute particles so as to have rather a granular than a vesicular appearance, it will be found that heating the specimen moderately has the effect of fusing the fatty particles so as to make them run together and form large drops of grease.

The number of fatty granulations scattered over the kidney is very various. In some cases there are only a very few, while in other instances they are very thickly disseminated through the cortical substance. It will be apparent, from what has already been said, that although, when present, they give a peculiar and characteristic appearance to the kidney, they are, at least in some cases, only a secondary consequence of the non-desquamative disease, which may, and often does, prove fatal without the occurrence of fatty degeneration in any form or degree.

It is probable that some of the oil is a product of the metamorphosis of a fibrinous or albuminous effusion into the tubes; but it is quite clear that only a small proportion of it can have this origin: for the greater part of the oil is contained in distinct cells; and these can readily be traced through a gradual series of transitions up to the gland-cells, of which they are, evidently, a degenerated offspring. Very frequently, too, the incipient tendency to fatty degeneration may be detected by a commencing accumulation of oil in the gland-cells, which still retain their normal form and position, while the canal of the tube is clear and contains no fibrinous or other effused product.

There is a remarkable difference in the tendency to fatty degeneration in different cases, as indicated by the period of the non-desquamative disease at which oily matter first appears in the urine. I am indebted to my friend, Dr. Tanner, for the opportunity of occasionally examining the urine of a patient under his care, in whom the non-desquamative condition had existed for many months before any signs of fatty degeneration were observed.

Case XXIV.

Dropsy, with highly albuminous urine, which at first contained neither casts of tubes nor renal epithelium; after some months waxy casts, and at a subsequent period, oily casts and cells.—Death from exhaustion; the kidneys in a state of granular fatty degeneration.

Elizabeth Quarmby, æt. 32, came under Dr. Tanner's care on the 31st of October, 1848. Five weeks previously she had been delivered of her tenth child, which she was then suckling. Before the birth of the child she had suffered from great œdema of the legs, which still continued, and her face was pasty and swollen. Her urine was at that time diminished in quantity, and loaded with lithates and albumen.

After weaning the child, and under the influence of good diet and tonics, her health began to improve, and the dropsy diminished.

By the month of February, 1849, she was much better, being able to go about easily; all dropsy had disappeared. The urine was still highly albuminous.

On the 31st of October, 1849, I first examined the urine. It contained a large quantity of albumen, and deposited a sediment composed of prisms of triple phosphate and pavement epithelium; the latter probably from the bladder, but neither renal epithelium nor casts of tubes were visible.

On the 4th of December I examined the urine with as nearly as possible the same result; but on this occasion I saw a very few small waxy casts.

Again, on the 24th of April, 1850, the urine was highly albuminous, becoming almost solid on the addition of nitric acid; sp. gr. 1022. It contained a few small waxy casts and some characteristic large waxy ones. Some of the small casts entangled here and there a cell of renal epithelium, but these were so few in number that the disease might correctly be designated non-desquamative.

In October of the same year (1850) there was again no distinct evidence of either casts or renal epithelium.

On the 6th of June, 1851, the urine was again examined. It was still highly albuminous, and deposited a rather abundant whitish sediment, which contained both large and small waxy casts, in some of which there were scattered oil-globules, and also cells filled with the same material. It was now, for the first time, evident that the kidneys were undergoing fatty degeneration. Meanwhile the dropsy had returned, and increased to such a degree that, in the month of July, it was deemed advisable to puncture the legs; and on the 23rd of

August a considerable quantity of liquid was removed from the abdominal cavity.

Both operations afforded much relief from the more urgent symptoms, but the patient gradually declined, and died on the 25th of November, 1851.

The kidneys were found to be good specimens of the granular fatty degeneration; and they presented, on a microscopic examination, the appearances which I have already described as characteristic of the disease in question. Many of the tubes were simply in the non-desquamative condition, the epithelium being opaque, and having a granular appearance, while in other tubes there might be seen the different gradations by which the epithelium undergoes degeneration. In some cells there were only a few small oil-globules; in others these were more numerous; then the cells were changed in form and completely filled with oil, the tubes being darkened by their accumulated contents, and subsequently, as it appeared, losing their form, being either ruptured from over distension, or shrunk from atrophy.

The muscular walls of the arteries were hypertrophied, and the Malpighian capillaries were thickened.

Opportunities may frequently occur for tracing the transition from the non-desquamative to the fatty disease of the kidney; but in no case which I have yet met with, has the simple non-desquamative condition existed for so long a time before the occurrence of fatty degeneration, as in the preceding instance. The combined weight of the kidneys was only $6\frac{3}{4}$ ounces. It was therefore evident that the glandular tissues had suffered atrophy, in consequence, probably, of the excess of morbid materials and uneliminated excrement in the blood, and the greatly impeded circulation which resulted from that condition. A diminution of the size and weight of the kidneys affected with this form of fatty degeneration is, however, as rare an occurrence as I have before (p. 368) stated it to be in cases of simple non-desquamative disease.

In a small proportion of cases some fatty granulations are found in kidneys which have suffered atrophy from chronic desquamative disease. The comparative rarity of this combination of morbid conditions is explained by the fact that the epithelial cells, which are the chief seat of the fatty degeneration, are continually becoming disintegrated and swept away by the desquamative process; so that the chances of fatty degeneration are in inverse proportion to the extent and activity of the desquamative disease. In a few cases I have observed the co-existence of the two forms of disease, as well from an examination of the urine during life as of the kidneys after death.

The period of the non-desquamative disease at which the signs of fatty degeneration present themselves is, as I have before said, very various in different cases. In the case of James Cowdry (p. 408), who was seized with renal disease during the convalescence from typhus fever, the signs of fatty degeneration were observed in the urine within a month from the commencement of the attack, and at the expiration of another month, when the disease terminated fatally, the kidneys presented the characteristic appearances of the granular fatty degeneration. The case of Stephen Gray (p. 411) appears to be an instance of fatty degeneration occurring in a still more acute form. When he first came under observation, he had been ill only three weeks, but there was unequivocal evidence of decided fatty degeneration, which was confirmed by the subsequent progress of the case.*

SECTION II.—MOTTLED FORM OF FAT KIDNEY.

In the cases of fatty degeneration to which I have hitherto referred, when the disease has terminated fatally the kidneys have been found to contain the fatty matter in the form of the characteristic yellow granulations, while the tubes in those portions of the gland which contain no granulations either have no oil within them, or only very slight traces of it. In a comparatively small number of instances fatty degeneration occurs in a very different form, as is evident both from the general appearance of the kidney when examined by the naked eye, and from the results of microscopic investigation.

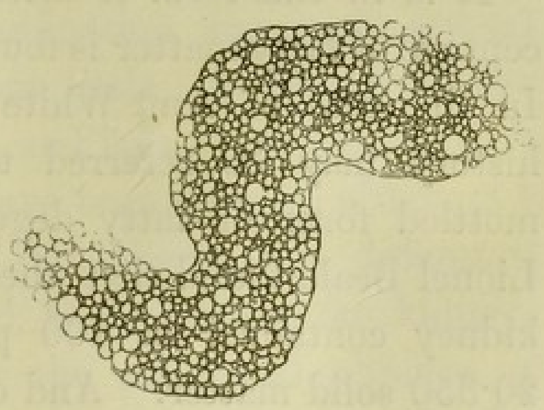
The kidney in the cases referred to is usually increased in size and weight; the colour of the cortical substance is either uniformly pale or more frequently mottled by red vascular patches, and occasionally hæmorrhagic spots are scattered over the cortical substance. The medullary cones retain their normal colour and vascularity. The consistence of the kidney is usually softer than natural, and frequently it has an œdematous feel and appearance.

On a microscopic examination the convoluted tubes are found to be everywhere greatly distended with oil, which has accumulated in their epithelial

* See the history, and remarks, p. 411.

cells. The oil-globules are usually of larger size than in the cases of granular fatty degeneration, and the detached epithelial cells, when filled with their oily contents, have often a remarkable resemblance to the cells of the liver in the same condition. There is no oil in the inter-tubular tissue, and rarely any in the Malpighian bodies. The tubes of the medullary cones are also free from deposit, except such as appears to have been washed into them from the convoluted tubes. The fatty accumulation, therefore, occurs in the epithelial lining of those portions of the tubes whose office is the secretion of the solid constituents of the urine. In some of the tubes the epithelial cells cannot be seen; they appear to have undergone a process of atrophy, and the tubes are occupied only by their oily contents (fig. 25).

Fig. 25.



Portion of a tube filled with oil-globules.

The Malpighian capillaries are opaque and thickened, and present, in all respects, the same appearances as have been before described in connexion with other forms of chronic renal disease. I can say nothing positive as to the condition of the arteries, for I have had no opportunity of examining a well marked specimen of the disease now under consideration since I first recognised the pathological changes which these vessels undergo. I anticipate, however, that their muscular walls will be found hypertrophied when the disease in the tubes has been of long standing.

The hæmorrhagic spots sometimes observed in the cortical substance are composed, as in other cases, of convoluted tubes filled with blood. There are none of the yellow granulations which are characteristic of that form of fatty degeneration which I have before described. The granulations in the cases referred to are, as I have already demonstrated, the result of certain sets of tubes being distended with oil, while the surrounding tubes are nearly or quite free from this material. But in the instances now under consideration, which, for distinction's sake, I propose to call the *mottled form of fatty degeneration*, the convoluted tubes are almost universally and equally filled with oil.

It is in this form of disease that the greatest per centage of fatty matter is found on a chemical analysis. In the case of Ann White (No. 27, p. 414), whose history may be referred to in illustration of the mottled form of fatty degeneration, my friend Dr. Lionel Beale found that the cortical substance of the kidney contained in 100 parts 79·650 water, and 20·350 solid matter. And of this solid matter 5·490, rather more than one-fourth, was fat. In another specimen, I found that the dried solids formed 24·5 per cent., and of this 3·5 was removed by digestion in ether, so that the proportion of fat was slightly above one-sixth of the solid constituents.

With regard to the symptoms of this form of disease—in the cases which I have met with when the kidneys have been in an advanced stage of degeneration, the condition of the urine and the general symptoms have not usually differed, in any respect, from those which I have already described in connexion with the granular form of fatty degeneration. The urine has been very albuminous; its specific gravity deviating little from the standard of health, and being quite as frequently above 1020 as below that point; its quantity is usually less than normal; when passed, its colour is natural, and after standing, it deposits only a slight cloudy sediment, in which may be found some small waxy casts, entangling scattered oil-globules and oil in cells.

I think it probable that in some cases of this form of degeneration there may be no appearance of oil in the urine. In one case I could detect none, although the kidney-tubes were found after death completely filled with oil. This examination was made several years ago, when I was but little accustomed to the examination of the urine; and it is quite possible that oily casts and cells may have been present, although I failed to detect them. But there is a difference between the mottled and the granular fat kidney, which would account for the occasional absence of oil in the urine of the former class of cases. In the granular kidney, many of the tubes contain a number of detached oily cells, which are readily washed out by the stream of urine passing through the tube; while in the mottled kidney there is commonly only a single layer of epithelium, which still remains adherent to th e basement membrane. This condition renders the escape of cells from the tubes scarcely possible; and the only way in which the oil could, in these circumstances, appear in the urine, is by the rupture of the cells, which, I believe, seldom happens, unless when fibrinous materials from the Malpighian bodies have coagulated in the tubes; in this case the fibrinous plug when it escapes may carry with it some oil from the ruptured cells over which it has passed in its transit through the tubes, and so the small waxy casts with oil may appear in the urine.

There is yet another important distinction between the granular and the mottled form of fatty degeneration. In the first-mentioned form of disease the formation of the fatty granulations is preceded, as I have already mentioned, by a non-desquamative disease; this being indicated by the condition of the urine, which is highly albuminous, clear, and without sediment; whereas the second form of fatty degeneration comes on very gradually and insidiously, and frequently makes great progress before the urine affords any indications of the existence of renal disease. I have occasionally found a large proportion of fatty matter in the renal epithelium after death, in cases which have certainly not been attended by the secretion of albuminous urine. This is the form of disease which Mr. Simon* observed in the kidneys of cats after the animals had been confined in a dark cellar, and which, I am told, is very common in London cats, even when

* See Mr. Simon's *Lectures on Pathology;* also *Med.-Chir. Trans.* vol. xxix. p. 15.

they have not been subjected to the depressing influence of close confinement. Dr. Beale informs me that he has at different times examined the kidneys of nine cats, and that in every instance he found the tubes distended with oil. These animals had all lived in a brewery, and had been well fed and indolent—a mode of life which is, of course, very unnatural for a cat.

It is a point of considerable interest to determine whether this fatty accumulation in the tubes is in itself adequate for the production of albuminous urine and the other consequences of renal disease. In the first paper which I wrote on the subject of Bright's disease, and which the Medico-Chirurgical Society* did me the honour to publish, I attributed many of the consequences of renal disease to the dilatation of the tubes by fatty accumulation, and a consequent mechanical impediment of the circulation. I at that time thought that the apparent difference between the effects of fatty accumulation in the liver and in the kidneys—the former organ suffering little, and the latter, as it seemed, much, from an identical condition of the secreting cells—might be explained by reference to the anatomical difference between the two organs. The fibrous rings of the matrix, and the vessels within them, would, as I thought, suffer compression when from any cause the uriniferous tubes became dilated, and in this way the circulation would be impeded. I am still of opinion that these mecha-

* *Med.-Chir. Trans.* vol. xxix.

nical conditions must exert a certain amount of influence, but I have long perceived that I was in error in attributing to them that degree of importance which I did in the paper referred to.

The phenomena of the non-desquamative disease have shown us that a fatal suppression of urine may be consequent upon a condition of kidney which is characterized by the almost total absence of any anatomical change in the organ. We have also seen that a form of fatty degeneration is one of the non-essential consequences of that condition of kidney. A consideration of these phenomena, and of the general history of renal diseases, will show the necessity for caution in attributing to morbid structural changes too much influence as causes of any symptoms with which they may have been associated. It cannot be doubted that a large and a general accumulation of oil in the renal epithelium is a morbid condition and an evidence of degeneration. But while we recognise the probability that this degenerated condition of the secreting cells may, at the same time, diminish the functional activity of the kidney, and be an efficient cause of further structural changes, we may also perceive the possibility that the altered appearance of the cells and the associated impairment of function may be only common consequences of a diminished vital activity, and of the loss of the normal relations between the blood and the secreting cells, such as we must assume to occur in cases already referred to, where there is no structural change in the kidney sufficient to explain the suspension of its functions.

The diseases which are associated with these two forms of fatty degeneration of the kidney do not differ essentially from those which are found to co-exist with other forms of chronic renal disease.* I had once an impression that it was rare to find an increase of oil in the kidney without a similar increase in the cells of the liver in the same subject. More extended observations have shown that this connexion is by no means constant, and I have sometimes found that when the cells of the kidney contained a large quantity of oil, those of the liver had much less than the usual amount of that material. In one case of diabetes which I examined, the contrast between the renal and the hepatic cells was very remarkable; the former were opaque, and contained a large quantity of oil, while the latter were deficient, not only in oil but in their usual granular contents. The appearance of the cells at once suggested the idea that while the renal cells had eliminated excessive quantities of materials rich in hydro-carbon, those of the liver had been comparatively inactive; in other words, that while the hepatic cells were starved the renal cells had been filled to repletion.

DIAGNOSIS AND PROGNOSIS IN CASES OF WAXY DEGENERATION, NON-DESQUAMATIVE DISEASE, AND FATTY DEGENERATION.

It will be apparent, from what has already been said of the forms of disease which I have described

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* See chap. iv.

under the names of waxy degeneration, non-desquamative disease, and fatty degeneration, that in many respects they are intimately connected with each other, and that, in a certain sense, one form of disease may be considered as a sequence or later stage of another. It has appeared to me that I could scarcely succeed in my endeavour to convey an accurate notion of the various structural changes which the kidney undergoes, without describing separately those pathological conditions, the distinctive features of which are more or less implied in the names by which they have been designated. It is certain, however, that unless these diseases are viewed in connexion with each other, and, indeed, with all the forms of renal disease, as well as with reference to the healthy structure and functions of the kidney, no adequate conception could be formed of any one of them. Between the diseases of any one organ there must, of course, be a bond of union, and many points of agreement; but without a separate consideration of each structural change, we could never hope to understand the complicated relations which exist between them, or to estimate rightly the degree of danger which each of them implies.

I purpose now to offer a few remarks on the subject of the three forms of disease now under consideration, with especial allusion to diagnosis and prognosis. Much of what I have to say upon these points will have reference to subjects which have already been fully discussed, with the addition of one or two remarks for which I have not hitherto found an appropriate place.

The *large waxy casts*, which are indicative of a similar deposit taking place in the tubes, may occur in connexion with almost every form of renal disease. They may co-exist with the epithelial casts in acute desquamative nephritis (chap. iii.), and with the granular casts in the chronic desquamative disease (chap. iv.); they may occur alone and in great numbers in connexion with an acute or chronic form of waxy degeneration of the kidney (chap. v.); and lastly, they may occur either alone or in conjunction with the small waxy or oily casts during the progress of the non-desquamative form of disease. In whatever circumstances they occur, they always take the place of the epithelial lining of the tubes, the casts themselves having the full diameter of the tubes. It is impossible to estimate rightly their significance either as regards diagnosis or prognosis, without a consideration of all the circumstances of the case in which they occur. Upon most of these points enough has already been said in the chapters just now referred to; with reference, however, to the association of waxy degeneration with the non-desquamative disease, as I have scarcely yet alluded to the subject, it will be well to do so now.

When describing the characters of the urine, in connexion with non-desquamative disease of the kidney, I stated that in many cases no casts of the tubes are visible, while in other instances some of the small waxy casts may be seen, and at a more advanced period, perhaps, these casts may contain oil in cells, and in the form of scattered globules. In a certain proportion of cases the small casts are associated with a few of the large waxy casts; the number is variable, and the casts have usually a less solid consistence and a less definite outline than in the more unequivocal cases of waxy degeneration of the kidney. These cases, however, form a bond of union between the simple non-desquamative disease and the waxy degeneration. The waxy material takes the place of the epithelium, and fills the tubes; the disease being chronic, if the waxy material escapes from the tubes in the form of the large casts, it probably is soon replaced by more of the same kind, the secretory functions of these tubes are suspended, their nutrition fails, and they become contracted and form the firm granulations which are sometimes seen projecting on the surface of the kidney. The case of Woodman, whose history has already been given (p. 333), is one of this kind; intermediate, as it were, between the non-desquamative form of disease and waxy degeneration; so that it is doubtful in which class it should be placed.

The difference in the effect upon the tubes of an acute waxy deposit and of a continued deposit of the same waxy material in a chronic form, is analogous to that which I have before indicated with reference to the acute and chronic desquamative process. As the acute desquamative disease may leave the tubes healthy and efficient for the discharge of their functions, while the chronic desquamative process entirely destroys the epithelial lining of the tubes, and suspends their secretory power, so it is probable that the tubes may quite recover their normal condition after being filled with the waxy material, as a result of acute disease (see the case of Hayden, p. 326), while a long continued deposit of the same material leads to the disorganization and atrophy of the tubes.

With reference to the prognosis in cases of the three forms of disease now under consideration, it should be borne in mind, that although the chemical and microscopic characters of the urine afford most important and, indeed, indispensable aid, yet that the prognosis should never be based upon these alone, without regard to other symptoms, and the general condition of the patient. This remark is as applicable to this subject as to that of physical signs in cases of thoracic disease. No one but an inexperienced practitioner would, in a case of pulmonary disease, be guided solely by physical signs in the decision of any doubtful question as regards either diagnosis, prognosis, or treatment. The physical and the general signs ought to be examined in every case, and each sign should be allowed to have its due weight. That the prognosis in all the forms of renal disease now under consideration is less favourable than in the cases of desquamative disease, is apparent from the actual results of the diseases, and the large proportion of cases which terminate fatally, from physiological considerations based upon the anatomical condition of the diseased organs, and from the circumstances in which these forms of disease occur. With reference to the last-mentioned point, it may be observed that these diseases frequently occur in those who are of a manifestly unsound constitution, or who have been previously subjected to noxious and depressing influences. A person of a scrofulous habit or tendency, who has been exposed to any of the exciting causes of renal disease, is perhaps more likely to become the subject of one of the more serious forms of disorder, than to be attacked by desquamative nephritis; and certainly he incurs a greater risk of this unfavourable result than a person who has previously been in good health and of sound constitution. The case of Woodman (p. 333) is an illustration of this point. The same remark is applicable to those whose strength has been reduced by severe acute or protracted chronic diseases, and to those who have been excessively intemperate, and who perhaps, at the same time, have suffered from a deficiency of nourishing food. The cases of Ager (p. 343), Cowdry (p. 408), and Lewis (p. 351), may be referred to in illustration of these remarks.

Although the three forms of disease now under consideration have all an unfavourable aspect and tendency, yet they are not all equally serious. It is difficult to propound general rules in the matter of prognosis, but with reference to these diseases there are a few plain facts and principles which will materially assist us in our attempts to form a sound judgment in any case. My experience of the acute form of waxy degeneration and of the acute form of non-desquamative disease is too limited to justify me in giving a very confident opinion as to the relative degree of danger which each of them involves. I believe, however, that in an acute attack, with urgent symptoms of suppressed secretion and impeded renal circulation, relief is afforded by any kind of effusion, whether of blood or fibrine, and I think a more hopeful prognosis may with reason be given, when, *cæteris paribus*, the urine contains either blood or the large waxy fibrinous casts, as in the case of Hayden (p. 326), than when there is no appearance of blood or fibrinous casts, as in the case of Ager (p. 343). The same remark applies to the cases in which the small waxy casts are visible, as in the case of Lewis (p. 351). Indeed, the appearance of the small casts in such circumstances is more favourable than that of the large ones, for the reason that the tubes in which the small casts are formed still retain their epithelial lining, while in the tubes which contain the large casts the gland-cells are replaced, for the time, by unorganized fibrine, and there must obviously be a greater risk of permanent injury to these tubes than to those which have undergone a less degree of structural change.

With regard to the prognosis in cases of chronic non-desquamative disease, the chemical and microscopic characters of the urine will afford most important and valuable aid. The quantity of albumen is, to a certain extent, an accurate measure of the strain upon the renal circulation, and of the degree in which the bloodvessels are gorged, and the functional activity of the kidney may be estimated by a comparison of the quantity with the specific gravity of the urine. A scanty secretion of urine, of low specific gravity, and highly albuminous, would indicate a degree of embarrassment of the circulation and of the secretory functions, which must occasion great risk of permanent structural changes in the kidneys, and which may lead to some of the serious consequences of suppressed secretion. The appearance of blood in the urine in such circumstances is rather a favourable sign, as indicating a comparatively early stage of disease; since in the advanced stages the Malpighian capillaries become so much thickened that blood can rarely escape from them. We must not rely too confidently upon this sign, since in almost all cases of chronic disease the bloodvessels are found unequally thickened, and even in the latest stages some vessels might be so little thickened as to give way and allow their contents to escape. It is a fact, however, that hæmorrhage is rare in cases of this chronic non-desquamative disease.

When the urine has been for a long time albuminous, the probability of a complete cure diminishes in proportion to the duration of this symptom; but the case of a medical practitioner alluded to at the conclusion of the last chapter (p. 374) is a remarkable instance of the long continuance of an albuminous condition of the urine, without disturbance of the general health, or any indications of serious structural changes in the kidney.

There are two kinds of casts which have an unfavourable significance; these are, the large waxy and the oily casts. The first kind of cast occurring during the progress of chronic non-desquamative disease indicates, as I have before stated, that the cells in some of the tubes are being replaced by unorganized fibrin, which subsequently contracts and forms the firm granulations by which the surface of the kidney is sometimes roughened.

We conclude, therefore, from the appearance of these casts, not only that the secretory functions are impeded, and the circulation embarrassed, but that the gland-cells are undergoing a process of degeneration.

This kind of degeneration is, however, less serious in its nature and consequences than that which is indicated by the appearance of oily casts and cells in the urine (p. 377). There is not one amongst the forms of renal disease whose history I have given, which may not prove fatal, and in the advanced stages of any of them there may be little to choose between those forms of disease which, in their origin and essence, are most favourable, and one which has essentially an unfavourable tendency. A man with acute bronchitis or pneumonia may be in as desperate a condition as another patient who has a tubercular cavity in the lung.

When describing the appearances observed in the urine during the progress of acute desquamative nephritis, I stated that in adults the temporary appearance of more or less of oil in the casts and cells is a common occurrence during the period of convalescence; and I intimated that in such circumstances these appearances rarely have a seriously unfavourable import (p. 91). The prognosis is, however, very different when numerous oily casts and cells appear in urine which is highly albuminous, but having nearly the natural colour, and depositing only a slight cloudy sediment, which is, for the most part, composed of the microscopic objects just now referred to. These appearances indicate as serious and intractable a malady as tubercular disease of the lung. *I have observed this condition of urine in a large number of cases, and in not a single instance has the urine regained its natural appearances, or ceased to be albuminous.*

Much may be done by care and judicious management to check and control the course of the disease, and to prolong the patient's life; but a complete cure of this form of disease is, according to my experience, scarcely to be hoped for. Now since this fatty degeneration is, in many cases, a secondary consequence, or a more advanced stage of the simple non-desquamative disease, it is manifestly of great importance to recognise the disease in its earlier stages, when the kidney has not yet undergone any serious structural changes, and to apply our remedies before that hopeful period has passed. It would be difficult to over-estimate the value of the means which we possess in a microscopic examination of the urine, for arriving at a correct diagnosis of these cases.

I have already stated (p. 391) that in cases of the mottled form of fatty degeneration it may sometimes happen, that with a large amount of oil in the kidneys there is none in the urine, which is highly albuminous, but contains no casts of the tubes, nor any kind of sediment. This, however, must be so rare an occurrence as to be of little practical importance.

It may be useful to refer to the circumstances in which the urine is sometimes found to be albuminous, with either no sediment, or a very scanty one, and with few if any casts of the tubes. This may happen 1st, during the convalescence from acute desquamative nephritis (p. 119); 2nd, in the advanced stages of chronic desquamative disease, when nearly all the tubes have been denuded (p. 185); 3rd, in the acute non-desquamative disease (p. 349); 4th, in the chronic non-desquamative disease (p. 358); and 5th, perhaps in some rare cases of the second form of fatty degeneration (p. 391). In each of these cases it would seldom be difficult to arrive at a correct diagnosis, from a consideration of the previous history and the attendant circumstances.

TREATMENT.

The treatment of the three forms of disease whose diagnostic signs we have now passed under review, must be regulated in accordance with the general principles which have already been fully explained in connexion with the acute and chronic forms of the desquamative disease (pp. 125 & 263). Our remedial measures must be modified according to the stage and intensity of the disease, but we have no specifics for the different kinds of tube-casts in the urine. This being the case, it may be asked why we insist so much upon the importance of an accurate diagnosis? The answer to this is sufficiently simple:—1st, that it is the only means we possess of predicting with any degree of certainty what will be the progress and the result of a disease; and 2nd, that the decision of many questions of the gravest importance to our patient, must frequently hang upon the opinion which we form as to the nature, the stage, and the probable consequences of his disease.

When describing the treatment of chronic desquamative nephritis, I referred to the benefits which may be derived from a change of air, and particularly from a sea voyage; and the remarks which I then made are applicable, in an especial manner, to the chronic forms of disease which are now more immediately under consideration. It will often be our duty to urge upon a patient the necessity for making a great immediate sacrifice by the temporary abandonment of his home and his calling, with the hope of ultimately recovering his lost health and strength. In advising such a course, we must be careful to avoid two errors to which we are liable; the one being that of banishing a patient whose illness is not of so serious a nature as to require such a means of cure, and the other, that of exposing to the perils of a journey by sea or land, one whose disease is in so advanced a stage, or of so intractable a nature, that rest and careful nursing at home are alone advisable. Cases will occur in the management of which it may be doubtful which is the prudent course to pursue, and for which it is difficult to prescribe particular rules. The practitioner will be least liable to err who takes the most comprehensive view of all the circumstances of the patient and of his disease.

With reference to the poor in large towns, a clear statement of the nature and probable consequences of the disease may sometimes call forth a charitable effort to give them the benefit of country air, at a time when, perhaps, this affords them the only reasonable hope of recovery.

When there is a decided tendency to fatty degeneration, it may be well to warn the patient against the use of fat food. Magendie has shown that when dogs are fed upon an exclusively fat diet they soon die, and on dissection, all their organs and tissues are found infiltrated with fat. Since abstinence from fatty articles of food is not attended with great inconvenience, and since it may be productive of good or prevent mischief, it is a precaution which should not be neglected in the cases referred to.

The treatment required for the dropsy and the other secondary consequences of these forms of renal disease, differs in no respect from that which has been before described as applicable to the same symptoms when occurring in connexion with the chronic desquamative disease. See chap. iv. p. 278, *et seq.*

Appendix to Chapter VII.

CASES OF FATTY DEGENERATION.

Case XXV.

Typhus fever followed by renal dropsy; urine scanty, albuminous, and of high specific gravity.—Epithelial casts, and subsequently cells, filled with oil. —Granular fatty degeneration of kidney.

James Cowdry, æt. 28.—Grocer's porter; health usually good; habits not very temperate. A native of London, where he has always lived; during the last few months he has fared badly, in consequence of being out of work: family healthy.

He was admitted into King's College Hospital on the 8th of December, 1848. He had typhus fever, and during his stay in the house the urine was examined two or three times, and found to contain no albumen. After being under treatment for nearly a month, he was dismissed cured, on the 3rd of January, 1849.

He was re-admitted on the 17th of February, when he stated that he did not regain his strength after his discharge, and that, about three weeks ago, his breath became short, his face puffy, and the legs and belly began to swell. He had not been exposed to cold.

There was then distinct fluctuation from effusion into the abdominal cavity, great œdema of the legs and puffiness of the face. Cheeks pallid, lips blue, respiration difficult. Sounds of heart normal. No apparent enlargement of the liver. He complained of pain in the loins. Pulse 100. Resp. 34.

Urine scanty, high coloured, clear, acid, sp. gr. 1020, loaded with albumen. On the 21st of February, Dr. Beale examined the urine, and reported that it contained transparent casts with epithelium, but no oil.

He was ordered to have dry cupping to the loins, and to take Pulv. jalapæ comp. ʒi. om. mane.

March 2nd.—The dropsy is undiminished, bowels freely open. The chief complaint is difficulty of breathing. Since the 27th of February he has taken a grain of blue pill twice a-day; the gums are slightly sore. Pill to be discontinued.

The urine now, and subsequently, was found to contain *epithelial cells with oil*, some of the oil-containing cells being entangled in the casts, and others scattered through the urine.

March 12th.—A slough has formed on the legs, from which a considerable quantity of serous liquid has been discharged. On the 9th he began to take ammoniæ muriatis, grs. v. in aquæ ℥iss. ter die.

His condition remained much the same, but the dropsy increased. The quantity of urine varied from 12 ounces to 24 ounces in the twenty-four hours, and its sp. gr. from 1022 to 1028. The albumen continued abundant. The transparent casts and epithelial cells containing oil were always visible. The urine was generally clear, but on one or two occasions it had an abundant sediment of lithate of ammonia.

On the 31st of March it was noted that he had an anxious look, but no headache or nausea.

April 1st.—He died suddenly this morning, as if from syncope. There had been no convulsions or headache.

Inspection, thirty-six hours after death.—There was a considerable quantity of serous liquid in the thoracic and abdominal cavities. The lungs were quite healthy, except that they were compressed by liquid in the pleura. Heart enlarged, but no disease of the valves.

All the abdominal viscera were healthy except the kidneys, which were sent to me for examination.

They were enlarged, their surface smooth and white, spotted over with small yellow granulations. The medullary cones had their normal appearance and colour.

The granulations were composed of convoluted tubes containing cells, which were filled with oil. In other parts some tubes were crowded with epithelium, while many tubes were filled with a white unorganized material which had taken the place of the epithelium: the material was probably of the same kind as that which had formed the transparent casts observed in the urine during life. In some parts where this material had been infiltrated it was difficult to make out even a trace of tubular structure.

Remarks.—The chief points of interest in this case are, 1st, the fact of renal disease coming on after an attack of typhus fever, and as this is by no means a rare occurrence, it will show the importance of watching fever patients during their convalescence, until the health is quite re-established. There is considerable risk in sending hospital patients to their unwholesome dwellings and their scanty and ill-regulated diet while any remains of a fever poison or of its products are left in the blood. 2nd. The history shows the rapidity with which the kidneys may undergo this form of fatty degeneration. There appears to have been no symptom of renal disease when he left the hospital on the 3rd of January; but he returned on the 17th of February, with general dropsy and albuminous urine. At first, the symptoms were those of simple, acute desquamative disease, but soon the signs of fatty degeneration were observed; these continued and increased, and death ensued on the 1st of April. As the dropsy had already existed for three weeks when he was readmitted, it is probable that disease commenced in the kidney very soon after he left the hospital, and as a consequence of exposure during the coldest season of the year; but even assuming that it commenced immediately, its entire duration did not exceed three months, and the signs of fatty degeneration were apparent a month before death.

Case XXVI.

Fatty degeneration of the kidney coming on rapidly, and probably induced by venereal excesses; at first general dropsy, with much blood and oil in the urine; afterwards, the urine clear, highly albuminous, and containing cells filled with oil, without dropsy, or disturbance of the general health.

Stephen Gray, æt. 23, was admitted into King's College Hospital, in October, 1846. He was suffering from general dropsy, and the urine was highly albuminous and bloody. He stated that he had been in good health until about three weeks before his admission, when he found, on getting up one morning, that his urine was deeply tinged with blood; and he imagined that this was a consequence of some injury which he had received during sexual intercourse. At that time he had been married only six weeks; he confessed that he had indulged his sexual appetite excessively, and attributed his illness solely to this cause. The urine continued to be mixed with blood; in about three weeks general dropsy came on, and on this account he applied for admission into the hospital. He was of small stature, very pallid, and had general dropsy in a considerable degree. The urine was deeply coloured with blood, and on a microscopic examination it was found to contain numerous cells filled in different degrees with oil. He remained in the hospital about a month, and was then discharged; the dropsy having entirely disappeared, and the urine being clear and free from blood.

I saw him again in August, 1847. The urine was then clear, of a pale sherry colour, sp. gr. 1021, highly albuminous, and contained small transparent casts, with epithelium, most of which was filled with oil.

My next report of him is dated January 25th, 1848. He has had no dropsy since he left the hospital, nor any return of hæmaturia; has enjoyed his usual state of health; his chief complaint is weakness, and occasional uneasiness in the loins; he gets up once in the night to pass water, and passes about two pints in twenty-four hours; it is clear and of a pale sherry colour; sp. gr. 1020; after standing, it deposits a slight white cloud, in which are found cells more or less distended with oil; no casts of tubes could be seen, nor any blood-corpuscles. Albumen so abundant as to occupy one-half the liquid after coagulation. At that time he was rather thin and pallid. He was still acting as waiter in a coffee-house. He had never been decidedly intemperate; but had taken three pints of beer a day, and occasionally a glass of spirits, but since his illness he has taken less; and he finds that he cannot now take a glass of spirits without feeling uneasiness in his back. I cautioned him as to his diet, and advised almost total abstinence from alcohol in all forms. I ordered him steel, which he continued to take for some weeks.

He told me that he had always lived in London, except once, for about ten weeks, four years ago, when he was a waiter on board an Antwerp steamer, and that he had never been so strong and well as during that time. I suggested to him the probability of a return to sea being attended with benefit, and that possibly it might cure him. He could not act upon this suggestion; but when I saw him in October of the same year (1848) he had left his situation as waiter, and was acting as a perambulating bookseller. He found that this more active life agreed with him better than his former business, and he considered himself quite well. The face was still pallid, but rather less so than at the time of the last report. His urine was clear, of a brown sherry colour; it deposited a light cloud after standing, in which were found cells filled with oil, as on former occasions; scarcely any casts of tubes; sp. gr. 1022; when boiled it became almost solid with albumen. He felt so well that he could scarcely be persuaded that he had any serious disease, and partly, as I suppose, on this account, and partly, perhaps, because I declined to patronize him in his new business, he has not since favoured me with a visit, so that, at this point, my account of him closes.

Remarks.—The history of this case, imperfect as it is, has in it much that is interesting and instructive. It appears probable that the kidney had undergone fatty degeneration very rapidly; it is also not unlikely that venereal excesses, acting upon a constitution previously enfeebled, had been the chief exciting cause of the disease. The later history of the case will show that the patient's own feelings could render little assistance in deciding the question as to the kidneys being in a healthy condition or otherwise at the time of his marriage. For since when I last saw him, and observed the condition of his urine, he had no suspicion, and could scarcely even be persuaded, that his kidneys were diseased; he may have been equally mistaken in supposing himself healthy at the time of his marriage. But the sudden occurrence of the dropsy, and the large quantity of blood contained in the urine when he first came into the hospital, are facts which point to a disease of quite recent origin. After the cessation of the hæmorrhage when he was in the hospital, there was no recurrence of hæmaturia in the two years during which he remained under observation. This affords an illustration of a general law, which has been before alluded to—that in recent acute attacks of renal disease, the Malpighian capillaries are often ruptured, and hæmaturia is a frequent occurrence; but when the disease has become chronic, it is seldom that blood in any quantity appears in the urine, in consequence of the thickened condition of the Malpighian capillaries enabling them to resist the pressure upon their walls which is occasioned by the continually impeded circulation through the kidney.

Case XXVII.

Two attacks of scarlet fever, without eruption, each attended by slight anasarca, the last attack three years before death, followed by an occasional recurrence of anasarca; at length general dropsy, with albuminous urine, containing fat epithelium; finally epileptic convulsions and death.—Fatty degeneration of the kidney; rather more than one-fourth of the solids of the kidney being fat.

Ann White, æt. 22, was admitted into King's College Hospital on the 21st October, 1848. Single, and a native of London, where she has always lived as a servant.

She had scarlet fever when 12 years old, and again three years ago. On neither occasion was there an eruption on the skin, but in both instances the attack was followed by anasarca of the lower extremities, which lasted only a few days. She states that after exposure to cold she has been liable to a recurrence of the dropsy. During the last few months she has had severe headaches, dimness of sight, and occasional vomiting; also pain in the loins, shortness of breath, and palpitations. She has always lived well.

Her present illness came on a fortnight ago, with swelling of the feet, ankles, and legs, and in a few days the dropsy became general.

At the time of her admission she had the appearance of having suffered from hæmorrhage, the face being very pallid; the whole body was anasarcous, and there was considerable effusion into the abdomen. The urine was dark-coloured, acid, sp. gr. 1025, almost solid with heat and nitric acid. It contained cells filled with oil.

She remained in the hospital about four months, during which time she continued to grow worse. She suffered chiefly from headache, frequent vomiting, shortness of breath, and pain in the loins. The urine continued to have the same character; it was generally scanty, and its specific gravity was high—generally above 1020—once only it was observed to be as low as 1016.

On the 17th of February she was, at her own request, discharged as incurable; and on the 2nd of March she died comatose, having had a great number of epileptic fits for a few days before.

The body was universally dropsical—liquid in the pleura and peritonæum; lungs healthy; heart small and healthy; liver congested, but not fatty; kidneys much enlarged, and of an almost uniform white colour in their cortical portion. The convoluted tubes were very greatly and almost universally gorged with oil. A portion of the cortical substance was analyzed by Dr. Beale, who found that in 100 parts there was 79·650 water and 20·350 solid matter. And of this solid matter 5·490—rather more than one fourth—was fat.

Remarks.—If the patient's history of herself was correct, she had two attacks of scarlatina, each of which was followed by dropsy. Perhaps the same peculiarity which rendered her liable to a recurrence of the fever was the predisposing cause of the dropsy, and both may have been connected with the incomplete character of the febrile attacks, there having been no eruption on either occasion.

She appears to have recovered completely from the first attack of dropsy, but after the last it is probable that an examination of the urine would have shown that disease still existed in the kidney, which having been neglected, and probably unsuspected, terminated in an extreme degree of fatty degeneration of the organ.

CHAPTER VIII.

SUPPURATIVE NEPHRITIS.

I PURPOSE in this chapter to give the history of those forms of renal disease which are attended with the secretion of pus: and in doing this, it will be convenient to divide the subject in the following manner:—

I. Suppurative nephritis from morbid conditions of the blood.
II. Nephritis from external violence.
III. Nephritis from retention of urine.
IV. Nephritis from calculi in the kidney.

SECTION I. SUPPURATIVE NEPHRITIS FROM MORBID CONDITIONS OF THE BLOOD.

In two preceding chapters (chap. iii. and iv.) I have described a form of disease which is characterized by a desquamation of epithelium from the uriniferous tubes, the primary cause of this pathological phenomenon being, as I have endeavoured to show, a morbid state of the blood, while the final cause or purpose of it is the elimination of the noxious materials with which the blood is supposed to be infected. The secreting cells are modified by the passage through them of materials different from those which they naturally secrete; the modification being shown first by a change in the appearance of the cells, and secondly by their being shed either in an entire form, or in a more or less disintegrated state, and so being visible in the urine. If these phenomena have been correctly interpreted, it will appear very probable that the more nearly the desquamated cells resemble the normal epithelium, the more favourable will be the aspect of the case. For it is likely that in these circumstances the materials to be excreted do not differ so essentially from the normal renal secretion, but that they may be effectually eliminated by the modified secretory process to which allusion has been made. Whereas, on the contrary, in proportion as the desquamated cells or the materials which, during the secretory effort, are cast off in place of the epithelium, differ in appearance and structure from the normal secreting cells, the greater will be the danger of serious consequences: for the reason, that a great departure from the normal cell growth is an indication that the materials which are to be eliminated differ in a corresponding degree from the natural constituents of the secretion; and, consequently, it is likely that the effort to cast them out will be unsuccessful, while the structure of the gland will be seriously impaired by the attempt. These anticipations are very generally confirmed by the results of actual observation and experience.

Amongst the most formidable modifications of the secretory process is that which consists, primarily, in a conversion of the epithelial cells of the kidney into pus, and subsequently in the extension of the suppurative process to the other tissues of the gland. The results of this form of disease vary much in different cases, according to the nature and intensity of the exciting cause. The most rapidly fatal instance of the disease which I have met with occurred in the subject of the following history, to the particulars of which, full of interest as it is, I wish to direct particular attention.

Case XXVIII.

Dropsy with albuminous urine from chronic desquamative nephritis. Successive crops of boils and carbuncles in the neck; then suppurative nephritis, first indicated by purulent casts in the urine. Death in a few days.—Abscesses in the kidneys, and smaller points of suppuration in the liver and lungs. Recent lymph on both pleuræ.

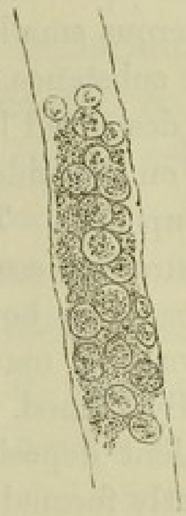
John Mac Clement, æt. 40, a compositor, was admitted into Lonsdale ward, on the 11th December, 1846. Has had much night-work, and his habits have been intemperate; has suffered from slight attacks of rheumatism, but not from gout. About four months before his admission his ankles began to swell, and soon afterwards the legs, face, and abdomen were similarly affected; about the same time he began to pass water more frequently than usual, particularly at night. On the 15th of December he is reported to be a large, strongly-made man, very pallid, with dilated pupils; suffers from headache; has general dropsy; gets up five or six times in the night to pass water; passes seventy ounces in twenty-four hours. The urine is acid, pale, limpid; sp. gr. 1010, very albuminous.

He was ordered middle diet; to take Tinct. ferri mur., ♏ x. three times a day; an occasional dose of compound jalap powder; and a hot-air bath on alternate days.

Under this plan, continued, with slight variations, for upwards of three months, he gradually gained strength, and his condition was much improved. One of the most important features of his case was the occasional appearance of carbuncles, or large boils, about his neck. Thus, on the 17th of December, it was noted that he has a carbuncle on his neck over the sterno-mastoid muscle; says he had a similar affection in the same place about a month ago. The carbuncle was lanced, and soon healed. On the 5th of January, he had 'boils on the right side of the neck, under the jaw.' These were very troublesome; they were lanced, and on the 23rd of January they were reported as nearly healed. On the 2nd of February, it was noted that several little carbuncular sores had again appeared on the neck; these were lanced, and on the 4th of February they had all coalesced into one sore about twice the size of a crown-piece. This sore was very painful, and was accompanied by rigors and diarrhœa. Before this large sore had healed another boil appeared over the spine of the left scapula; this was about 25th of February. On the 25th of March the sores had all healed. At this time his appearance indicated a greatly improved state of health. On the 30th of March he was reported as still improving. The urine had been frequently and carefully examined; the albumen diminished, but in other respects its condition had varied little since his admission; the average quantity was rather more than seventy ounces in twenty-four hours, and its sp. gr. 1015.

On the 6th of April, I was surprised to find that the urine had undergone a sudden and great change. To the naked eye its appearance was but little different from that which it had presented on former occasions; but it deposited a light, cloudy sediment which, on a microscopic examination, was found to contain numerous casts of tubes entangling pus-corpuscles, (Fig. 26, was taken from the urine of this patient,) there was also a considerable quantity of free and scattered pus. Albumen abundant; sp. gr. 1011. Feeling assured that this condition of urine was a sign of serious import, I went to the patient and questioned him as to the probable cause of the change. I found that for some days previously he had been allowed to leave the hospital daily for the sake of getting air and exercise; and, after some hesitation, he confessed that he had availed himself of this opportunity to indulge his appetite for intoxicating liquors; he had taken spirits, in addition to about a pint of wine each day. When I told him of my fear for his safety, he seemed surprised at my anxiety, and assured me that he felt better than he had been at any time since his admission into the hospital. At this time the only indication of any constitutional disturbance was a confused expression of countenance. He was now ordered to lie in bed. On the 8th of April his intellect was much confused, so that he could not remember the day of the week. The purulent deposit in the urine was more abundant. On the 10th, the expression of his countenance was very confused; memory greatly impaired; appetite bad. He was ordered to have a warm bath; a blister to the nape of the neck; eight leeches to the loins; and to take small doses of Dover's powder, with nitre.

Fig. 26.



Purulent cast, from the urine of MacClement.

On the 12th he lay in a stupid, half-conscious condition; said he was better and had no pain; there was great swelling of the cellular tissue of the neck beneath the jaws, so that he could not protrude the tongue. Pulse 100. Urine high-coloured, acid; sp. gr. 1014; albumen very abundant; a copious deposit of pus. On the 15th, small crepitation and a friction sound, accompanying the respiratory movements, were heard on both sides of the chest; there was œdema of the side of the body on which he lay.

He gradually sank, and died on the night of the 14th, remaining half-conscious and declaring himself better until within an hour of his death.

Inspection.—Both kidneys were enlarged to nearly twice their natural size, of a yellowish-white colour, and their substance, for the most part, firm. In the left kidney there had been extensive suppurative inflammation, two abscesses larger than walnuts had extended to the surface, and there were numerous smaller points of suppuration throughout the cortical substance. Two of the medullary cones were in great part destroyed by suppuration. The inner surface of the renal vein on this side was very red, and had deposits of lymph and pus upon it. The right kidney had several small points of suppuration scattered throughout its substance. All the abscesses in both kidneys were surrounded by an intensely red vascular margin, and had evidently been quite recently and rapidly formed. On a microscopic examination, besides the purulent deposits, some of the tubes were seen filled with recently formed epithelium, and others presented the ordinary appearances of chronic desquamative nephritis, some tubes being denuded, some containing particles of disintegrated epithelium, and others oil-globules.

The liver was large and had a pale nutmeg appearance. It contained several points of suppuration about the size of small peas. On a microscopic examination there appeared evidence of a rapid and recent formation of epithelial cells, analogous to the process of desquamation in the kidney; the older cells being of a yellowish colour and containing particles of bile, while those cells which were probably of more recent date were pale and appeared to contain no bile. The quantity of oil in the cells generally was rather less than usual.

Both lungs contained many small abscesses, and both pleuræ were covered with recently effused lymph.

The history of the preceding case renders it likely that the form of renal disease under which the patient was labouring until within a few days of his death, was chronic desquamative nephritis.* It seems

* As to the precise condition of the kidney before the sudden commencement of the suppurative disease I have some doubt. I have not the same confidence in the accuracy of observations made five years since, as I might reasonably have in some which have been made more recently.

highly probable that there was an intimate connexion between the fatal attack of suppurative nephritis, and the successive crops of boils and carbuncles which, during several months before, had appeared, at intervals of a few days, in the cellular tissue of the neck. It is reasonable to suppose that the carbuncles were the result of an effort to cast out of the body some noxious matter which was continually generated within it, and that finally this poisonous material was determined to the kidneys by the diuretic action of the stimulating drinks in which the poor man unfortunately indulged at a time when, in accordance with the course which the disease had taken during the preceding six months, another set of boils or a carbuncle would shortly have appeared in the neck. The poison was thus diverted from its ordinary channel into one which speedily led to fatal results.

It is interesting to observe that the first indication of the serious change which the renal disease had undergone was derived from a microscopic examination of the urine; and this, too, at a time when there were but slight indications of any constitutional disturbance. The formation of pus in the uriniferous tubes, and the appearance of the purulent casts in the urine, were doubtless the result of an effort to eliminate by this means what I will venture to call the carbuncular poison. The normal epithelium in some of the tubes was replaced by pus, which soon filled the tubes, and quickly passed through their walls with a rapidly destructive progress. On the left side the renal vein became involved in the disease;

but this was evidently a secondary result, and not an essential part of the disease, for the veins of the right kidney had no appearance of inflammation.

Besides the suppurative process, there had been in many, perhaps in most, of the tubes a very active desquamation of epithelium, as was shown by the tubes being filled with their epithelial contents.

A question now arises as to the connexion between the renal disease and the purulent deposits in the lungs and in the liver.

That the renal disease was primary, seems to be indicated as well by the early appearance of pus in the urine, at a time when there was no indication of disease elsewhere, as by the greater extent and progress of the disease in the kidney. It appears probable that the suppurative disease in the left renal vein may have been a source of purulent infection, and that the small abscesses in the lungs and liver were consequent upon this. Another explanation which may be suggested, but which appears less probable, is, that the morbid matter, which has been assumed to be the primary cause of all the mischief, attacked independently and almost simultaneously, but in different degrees, the kidneys, the liver, and the lungs.

With reference to the assumed existence of a morbid poison as the cause of carbuncles, I am induced to support the opinion which I have adopted by the following extract from Sir Benjamin Brodie's *Lectures on Pathology and Surgery*; at page 392 of that work Sir B. Brodie says:—

'I do not believe a carbuncle to be a mere local affection; it is a constitutional disease, and is always preceded by something wrong in the general health. It seems to me as if there were something like a poison in the circulation, which is thrown out of it into the cellular membrane in cases of carbuncle, so that we might be justified in classing this disease with small-pox and the other exanthemata. In a case of small-pox, there is first an attack of fever, which is relieved as soon as the pustules appear; and as these contain the variolous poison, there is little reason to doubt that it is the expulsion of the poison from the circulation that relieves the fever. The case which I am about to relate seems to indicate that something like this happens in cases of carbuncle.

A gentleman, an old acquaintance of mine, formerly a surgeon of eminence in a provincial town, but who had retired from his profession, about sixty-three or sixty-four years of age, called upon me some years ago, at my own house, in the morning, and said he had a complaint in his back, and that he suffered a great deal of pain. On examination I found that there was a carbuncle. I sent him home, having told him to poultice it. Two or three days afterwards, it being, as I supposed, in a proper state for the operation, I made a crucial incision through it. He was very much relieved, and was going on well, when there appeared another carbuncle, but on a smaller scale than the first. It was not a pimple in the skin, but the subcutaneous form of the disease. I told him what I believed to be the case. He said that it did not give him a great deal of pain, and I therefore thought it would be better to let it advance a little further before I opened it. It went on increasing, the skin over it became purple, and it was assuming the ordinary appearance of carbuncle. In the meantime he continued well in health, and appeared indeed to have scarcely any ailment, except the local complaint. But a day or two afterwards, on calling upon him, and believing that it would now be right to incise the tumour, I found him in bed. On inquiring the cause, he said in a faint voice, 'Oh! my dear friend, I am dying.' I expressed a hope that that was not the case. 'Oh, yes!' said he, 'I am dying.' I found that, indeed, his words were true. His skin was cold and clammy, and his pulse scarcely perceptible. I asked him how long he had been in that state? His answer was, 'During the night all the pain subsided, and, at the same time, I became ill. I believe the carbuncle itself has disappeared.' And so it had. When I examined the back I could find scarcely a vestige of it. He died in less than twenty-four hours after this change had taken place.

'Another circumstance is worthy of notice, as confirming the view which I have taken of the pathology of this disease. It frequently happens, when a patient has recovered from a large carbuncle, that other smaller ones, like boils, appear on different parts of his body; and a succession of these, gradually becoming smaller and smaller, may continue for many months, or even for one or two years.'

Suppose it to be admitted that a carbuncle is the result of an effort to eliminate some noxious matter from the blood, the question might be asked, Why should this be done by a process of suppuration? and why, in the case of MacClement, were the epithelial cells of the kidney converted into pus, when in other instances, referred to in previous chapters, morbid matters of various kinds are supposed to be eliminated by a simple desquamation of the epithelium? To these questions I can only reply, that we may hope to answer them fully and satisfactorily when it is ascertained why the poison of small-pox produces suppurative inflammation of the skin, while that of scarlatina excites only erythematous inflammation, followed by a cuticular desquamation.

Without attempting to explain the mysterious conversion of a normal gland-cell into a pus-corpuscle, or, to speak more guardedly, the replacement of one form of cell by the other, in the effort to cast out a noxious material, I will give another example of the occurrence in a case which differed in some important respects from that of Mac Clement.

Case XXIX.

Exposure to cold and wet, followed by diarrhœa, pain in back, and dropsy.—Urine albuminous, and containing purulent casts of tubes.—Erysipelas of face, legs, and scrotum.—Chronic peritonitis.—Kidneys enlarged, with purulent cells in tubes.—Liver small, and its cells much changed.

Joseph Tisdell, æt. 65, a Thames police-officer, was attended as a dispensary patient, in July, 1849. States that he has not been intemperate; never had gout or any serious illness, except once, an attack of cholera, until about seven months ago, when his present illness began. He was much exposed to wet and cold on the river, and wore a coat which was continually saturated with wet for two or three days. He was quite well before this, but two or three days afterwards he was seized with diarrhœa, and has been ill from that time. The bowels have since been very irregular, sometimes relaxed, and at other times confined. He had much pain in the back, the urine became scanty and high coloured, and sometimes had an unpleasant smell. About three weeks ago the legs began to swell; a week afterwards the swelling appeared in the abdomen, and, at the same time, erysipelas came on in the face and legs. It was for this illness that I was first asked to attend him. The first week in July there was erysipelatous redness of the face, scrotum, and legs; there were, besides, considerable dropsical swelling of the legs and liquid in the abdomen. The urine had a sp. gr. 1017; feebly acid, and had a peculiar, rather fœtid smell. It contained a moderate quantity of albumen. After standing, it deposited an abundant whitish sediment composed of cells, having all the characters of rather large pus-cells, and showing the compound nuclei after the addition of acetic acid. Many of these cells were clustered in the form of cylinders, and had evidently been moulded in the tubes of the kidney, but no connecting material was visible. There were many scattered cells of the same kind. No epithelium, nor any blood-corpuscles. When liquor potassæ was added to the sediment it became very viscid and stringy.

At first he took a saline mixture and had warm fomentations, and under this treatment the erysipelas soon subsided, but he continued very weak; occasionally he was troubled with hiccough. The bowels were generally costive, and he always felt relief from aperient medicine.

The dropsy of the legs and abdomen continued. *He never complained of pain or tenderness when the belly was examined by pressure and percussion.*

On the 11th of July he began to take Tinct. ferri sesquich. ℳ x. Acid. hydrochl. dil. ℳ x. with infusion of quassia three times a day. He took this mixture for a few days, and afterwards one containing carbonate of ammonia, with a small quantity of rhubarb. Occasionally he took a small dose of elaterium, from the hydragogue action of which he always experienced relief.

The urine continued to have the same characters, but became more scanty. The dropsy remained, and the patient became weaker, without any decided change of symptoms, until July the 28th, when he became suddenly faint, and died while sitting on the night-stool.

Inspection, two days after death.—Decomposition was rapidly going on. The abdomen contained about two gallons of clear serum. The peritoneum was everywhere thickened and roughened by a deposit of rather firm lymph, the result of general chronic peritonitis. The bloodvessels were much congested and of a dark red colour. There were no loose flakes of lymph in the liquid of the abdominal cavity.

The liver was about one half the natural size. It was soft, of a yellowish colour, and had a granular appearance. The secreting cells had an opaque, yellowish-brown appearance, being filled with an unusual, brown, finely granular matter, which concealed the nuclei. A very few cells contained an excess of oil. There was no biliary tinge in the skin or conjunctiva.

The kidneys were somewhat increased in size; one weighed $4\frac{3}{4}$ ounces. Texture rather soft; surface nearly smooth, but there were some small patches depressed by atrophy. They were irregularly mottled by a whitish deposit occurring in patches. Where the deposit was less abundant the vessels were congested.

On a microscopic examination the deposit was found to have the same characters as the sediment which had been observed in the urine. It was composed of pus-cells without an admixture of liquid, so that it did not form abscesses as in the case of MacClement. Where the deposit was in greatest quantity there was no appearance of tubular structure, the field being filled with a mass of pus-cells, but where it was less abundant the pus was seen to be within the tubes, which were completely filled by it. In the parts already mentioned as congested, some tubes were filled with epithelium and there was a gradual transition from this condition to that of other tubes which contained the pus-cells.

The Malpighian capillaries were opaque and showed the blood-corpuscles within them apparently magnified and colourless (see p. 101).

The heart and lungs were sound.

The exciting cause of the mischief in this case had apparently been exposure to wet and cold. The disease must have been very general, as shown, not only by the condition of the liver and kidneys, but also by the inflammation of the skin and peritoneum. The peritonitis might be said to be entirely latent, for, as already mentioned, he never complained of pain or tenderness. It would be difficult to point out the order in which the various diseases occurred, and to assign to each its share in producing the others; but, without doubt, the blood was the centre from which they all proceeded. And as the condition of the great secretory organs probably originated in an effort which they had made to eliminate some unusual material, so the change of structure which they underwent, and the consequent impediment of their functions, would react upon the blood, and add to its impurities.

The appearances in the kidneys showed, in an interesting manner, the transition from epithelial cells to pus-corpuscles; some tubes being filled with desquamatial epithelium, others with pus, while in other parts the pus cells had accumulated so much as to destroy all trace of tubular structure. The pus had not the characters of ordinary matter. It was composed of the corpuscles without the liquid portion, so that it did not form abscesses, as in the case of Mac Clement; but the tissues of the kidney were infiltrated in patches with what, to the naked eye, had the appearance of lymph. The cells had the same structure as ordinary pus cells, but they were somewhat larger;

and this was apparent as well in those which formed the casts which were seen in the urine during life, as in those which were found in the uriniferous tubes after death. I believe that the large size of the corpuscles will serve to distinguish that form of suppurative disease which merely fills the tubes with the cells in question, as in the case of Tisdell, from that which leads to the formation of abscesses in the kidney, as in the case of Mac Clement.

I have observed in two other cases precisely the same appearances in the urine as were presented in the case of Tisdell. One was the case of a woman about 70 years of age, who was dying with general dropsy. I saw her only once, and made but one examination of the urine. I had no opportunity of examining the kidneys after death.

The other case was that of a man, named Elvins, æt. 52, whom I saw with my friend, Mr. Henry Smith. He had led a very intemperate life, and had suffered frequently from gout. His health had long been declining, when, in the month of December, 1848, he was suddenly seized with general dropsy. The urine was highly albuminous, and contained purulent casts and scattered pus-corpuscles, similar to those in the case of Tisdell. At that time the lungs were much gorged, and he was in imminent danger of suffocation. The more urgent symptoms gradually subsided, and after a time the pus disappeared from the urine, which, however, continued to be albuminous, and contained the granular casts which are diagnostic of chronic desquamative disease. The dropsy continued; the belly became much distended, probably in consequence of hepatic disease; he gradually lost flesh and strength, and died of effusion into the pericardium, in the month of September, 1849. I was out of town at the time, and consequently did not see the kidneys.

When I first saw the patient, and detected the purulent casts in the urine, I predicted that the disease would soon end fatally. The subsequent progress, and the long duration of the disease, taught me that my prognosis had been too unfavourable; and a comparison of this with other cases has convinced me that a disease marked by the presence of purulent casts in the urine need not of necessity terminate fatally, although the appearance of such casts is a very unfavourable sign. The pus-cells in the cases of Tisdell and Elvins were larger, and appeared to have thicker walls, than those in the case of MacClement; but in all these the corpuscles presented the characteristic appearance of the compound nuclei, on the addition of acetic acid. It appears likely that the corpuscles in the two former cases were less essentially different from the epithelial cells than in the last case, in which the rapidly destructive progress of the disease, as well as the microscopic appearances of the cells and casts, indicated a widely different malady.

In one case I observed that the cells entangled in the casts approached still more nearly to the normal epithelium, and appeared to occupy a position intermediate between the cells which were seen in the urine of Tisdell and Elvins, and those which are commonly observed as a result of acute desquamative nephritis. The cells in the case to which I allude were not larger than those in the case of Tisdell, but, *instead of the compound nuclei, which are characteristic of the pus-corpuscle, they had only a single nucleus, like that of an epithelial cell.* The urine was dark-coloured, scanty, and albuminous; there was dropsy of the legs and belly, and there was tubercular disease of the lung, of which the patient died some weeks after I first observed the above-mentioned cells in the urine. The body was not examined after death.

It appears, from a consideration of the preceding facts, that the desquamative and the suppurative processes in the kidney are much more closely allied than the observation of their ultimate consequences would lead one to suppose. We have seen them passing into each other by almost imperceptible gradations, and their products co-existing in the same kidney; and we have good reason for the belief that, whatever may be the final results of these morbid processes, they all originate in a beneficial effort to eliminate noxious matters from the blood.

A good illustration of morbid changes commencing in the gland-cells, and gradually going on to the formation of pus, is afforded by the history of the following case, which is not the less interesting on account of the *liver* being the seat of the morbid changes; for, by the light of an advancing pathology, it will be apparent that there must be a close resemblance between the diseases of two organs which, with some important differences as to structure and functions, have yet so many points of agreement as the kidney and the liver.

A man died in King's College Hospital under the following circumstances. About two months before his death he had received a blow on the epigastrium; this was followed by severe pain in the region of the liver, and ultimately jaundice came on.* On the under surface of the liver, between the two lobes, there was a large hydatid cyst. The hydatid had escaped into the peritoneal cavity, the cyst having, probably, been ruptured by the blow just now mentioned. The cyst contained blood; and in the substance of the liver, for some distance round the cyst, there were numerous abscesses, varying in size from a pin's head to a large walnut. The pus in most of the abscesses had a yellow biliary tinge.

Dr. Budd, under whose care the patient had been, desired me to examine the liver, for the purpose of ascertaining the nature of the connexion between the hydatid tumour and the surrounding abscesses.

On examining sections of the diseased parts under water, we observed that some lobules had an abnormal dark greenish colour, as compared with that of the healthy portions of the gland; others were decidedly yellow, but still firm, and others, again, were just breaking down into yellow pus. We concluded that these various shades of colour, as seen by the naked eye, indicated the steps by which the lobules were converted into points of suppuration, and this impression was confirmed by a microscopic examination of the tissues.

In those lobules which had the natural colour, the secreting cells were normal, presenting the usual appearance of nucleus, granular biliary matter, and oil. In the dark green lobules many of the cells were opaque, being filled, as it appeared, with a peculiar whitish material, which concealed the nucleus; in these cells no oil or biliary matter was seen, but the new material, just now mentioned, seemed to form the sole contents of the cells. In the lobules which had a yellow colour some of the cells had the same appearances as those in the

* A more complete history of the attack will be found in Dr. Budd's treatise *On Diseases of the Liver*, 2nd Edition, p. 90.

green lobules, while others contained an excess of yellow biliary matter, and there was a considerable quantity of the same biliary matter free, and scattered amongst the cells; and, again, in some of the yellow lobules pus-corpuscles were mixed with the other materials. Lastly, in the fully-formed abscesses there was a mixture of pus-corpuscles with granular particles of bile, which gave a tinge to the pus.

The portal and the hepatic canals and the bloodvessels presented no appearance of disease, except in some parts, where one of the larger abscesses had encroached upon and extended into one of the canals.

The morbid changes had evidently originated in the lobules and in the secreting cells; the probable explanation of the whole process being, that some of the irritating contents of the hydatid cyst had entered the portal vein; possibly through the open mouths of the vessels which had poured the blood into the cyst. The infected blood was conveyed to the lobules, and an effort was made to eliminate the morbid matters through the agency of the secreting cells; an effort which changed the appearance of the cells, filling them with a new material, and finally leading to the rupture of the cells and the mixture of their scattered contents with organized pus-corpuscles. The softened lobules then broke down, and, becoming blended with each other, formed abscesses of various sizes.

Whatever may be the mode in which secondary abscesses are ordinarily formed, it was evident that in this instance the first perceptible morbid change occurred, not in the canals of the bloodvessels, but in the secreting cells of the gland—a phenomenon precisely similar to that observed in the case of Mac

Clement (p. 419), when the escape of the purulent casts indicated the commencement of the renal disease.

DIAGNOSIS OF SUPPURATIVE NEPHRITIS.

Very little need be added to what has already been said on the subject of the diagnosis of those cases of suppurative nephritis which originate in a morbid condition of the blood. The morbid products being formed and moulded in the tubes, appear in the urine in the form of purulent casts of the tubes. But as the disease advances, some of the purulent products will be scattered through the urine and present no appearance of being moulded in the form of cylinders. The reason of this is apparent from a consideration of the morbid anatomy of suppurative nephritis. I allude particularly to the tendency which this form of disease has to extend through the renal tissues by the destruction of the basement membrane of the tubes; as a consequence of which all trace of tubular structure disappears in those parts where the disease is most advanced, and the morbid products which escape from these portions of the kidney do not, of course, present any appearance of having been moulded in the tubes. In such cases the diagnosis as to the origin of the morbid products must be based upon the fact that amongst the scattered and unmoulded pus there is some—the proportion varying in different cases—which has the form of tube-casts.

It is important to bear in mind that during the progress of almost every form of renal disease, the bladder, being irritated by the contact of morbid urine, frequently throws off its epithelium, and with it a certain number of pus-corpuscles.* In such cases the pus is either scattered or collected in irregular clusters—*it is never moulded in the tubes;* and this is the diagnostic sign.

It is very rare to find a purulent cast in the urine during the progress of any of the forms of disease which have been described in the five preceding chapters, and it is equally rare to find purulent products in the kidneys after death. In some rare cases, as I have shown, the desquamative and the suppurative processes co-exist in the same kidney, but as a general rule the line of demarcation between them is very definite; and it is a great pathological error to suppose that suppuration in the kidney always depends on a greater intensity of the same morbid action as that which excites the desquamative process.

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* There is no term which has been more absurdly misapplied, or which has been the source of more confusion, than the word *mucus.* Every *healthy* mucous membrane has its own peculiar mucous secretion. The mucus which is formed by an *inflamed* mucous membrane, and which is composed of what are sometimes called mucous-corpuscles, is essentially pus. The corpuscles show the compound nuclei on the addition of acetic acid, and cannot by the microscope be distinguished from the pus-cells which are formed in an abscess. The difference between the pus from an abscess and the purulent secretion from an inflamed mucous membrane is, that the *liquor puris* of an abscess is always highly albuminous, while the morbid product of a mucous membrane is albuminous or not, according to the intensity of the inflammation. The corpuscles in all cases are essentially the same: it is only the liquid portion which differs. Some pavement epithelium is often mingled with the pus from an inflamed mucous membrane, but this is always recognised as distinct from the pus-cells.

There is another class of cases in which the urine contains a variable quantity of pus, having its source in the bladder, which is irritated by alkaline urine—the kidneys being quite healthy. In such cases there are the usual signs of the phosphatic diathesis. The urine contains an abundant sediment composed of prisms of the triple phosphate, mixed with pus-corpuscles scattered or irregularly clustered, none having the form of tube-casts. When the urine is very alkaline and ammoniacal the pus-corpuscles are broken down by the action of the alkali, and the so called 'ropy mucus' is the result. In some cases, when there is great irritation of the bladder, a serous liquid being poured out with the pus renders the urine albuminous; and in such instances there may be a suspicion of renal disease.

It is important to remember the possibility of renal disease being associated with the phosphatic diathesis,* and therefore to search carefully for renal products amongst those materials which are derived from the bladder. So long as the urine is either free from albumen, or only so slightly coagulable as would be accounted for by the purulent secretion from the bladder, there is no reason to fear the existence of renal disease; but when the urine is found to be highly albuminous, at the same time that it is abnormal in quantity—either scanty or unusually abundant—and of low specific gravity, there is ground for suspecting an

* In the case of Brooks (No. 12, p. 300) there was, during the later periods of her illness, an abundant phosphatic deposit, which concealed the tube-casts.

unsound condition of the kidneys, more especially when there is dropsy or any other of the secondary consequences of renal disease. This suspicion will be converted into certainty should we find some of the forms of tube-casts which are diagnostic of renal disease. In such cases the examination of the renal products is much facilitated when, by treatment directed to the correction of the alkaline condition of the urine, the phosphatic deposit has been removed, and the vesical irritation and secretion are diminished.

It will of course be understood, that when renal disease is associated with a purulent secretion from the bladder, the morbid process in the kidney is not necessarily or frequently of the suppurative kind. Any form of renal disease may co-exist with such a condition of the bladder. There is at present in the hospital a patient whose urine contains a considerable quantity of pus, the source of which is in all probability the bladder, and who has besides pretty certain indications of non-desquamative disease in the kidney.

PROGNOSIS.

The prognosis must always be unfavourable when the microscopic characters of the urine indicate that pus-corpuscles are taking the place of the renal epithelium. The suppurative process is much more rapidly destructive in some cases than in others, as may be seen by the histories contained in this chapter. I have before (p. 430,) indicated a difference in the appearance of the pus-corpuscles, which seems to be associated with a marked difference in the intensity and rapidity of the morbid process.

There appears to be this essential difference between the desquamative and the suppurative process in the kidney,—that the former is confined to the tubes, which retain their form after being filled with desquamated epithelium, while the suppurative process, although commencing in the tubes, destroys the basement membrane, and so inflicts irreparable injury upon the tubular structures. I have as yet met with no case of suppurative nephritis, of the kind described in the preceding pages, which has terminated in recovery. It is quite possible that a favourable result may sometimes occur, and our expectation of such an event would be greatest in those cases where the morbid products deviate in the least degree from the normal epithelium of the kidney. (See p. 432.)

TREATMENT.

It is not on account of any peculiar treatment being required in cases of suppurative inflammation of the kidney, that it is important to distinguish this form of disease from simple desquamative nephritis. An exact diagnosis, however, contributes essentially to accuracy in prognosis—and such help is not likely to be undervalued either by the practitioner or by his patients. For the general plan of treatment I refer to the directions given for the treatment of acute desquamative nephritis (p. 125), and I have only to say in addition, that the remedies must, in these cases, as in those of acute desquamative nephritis, be adapted to the stage and intensity of the primary malady, as well as to the nature and urgency of the secondary consequences of the renal disease.

SECTION II.—SUPPURATIVE NEPHRITIS FROM EXTERNAL VIOLENCE.

Suppurative inflammation of the kidney from external violence is not a common occurrence. I have met with one case of the kind.

Case XXX.

A violent blow on the loins, followed by occasional attacks of hæmaturia, and subsequently by a purulent discharge with the urine.—Death from exhaustion.—Abscess in the right kidney.

George Doe, a strong man, about forty years of age, and in robust health, received a violent blow on the loins from a bludgeon during a conflict with poachers. He suffered much pain, and within a short period after the receipt of the injury he had hæmaturia. The bleeding recurred at intervals during several months, and was succeeded by a discharge of pus with the urine. The purulent discharge continued for a period of more than a year, when the poor man died, much emaciated. On a post-mortem examination the right kidney was found completely destroyed by suppurative inflammation; there was no strumous deposit in the kidney or in any other organ. There was no calculus. The left kidney was quite sound.

There appears little reason to doubt that the renal disease in this case was excited by the blow on the loins.

DIAGNOSIS.

The diagnosis of such cases can seldom be attended with difficulty. In a case, somewhat similar to the preceding, of hæmaturia after a blow on the loins, I found the blood moulded in the uriniferous tubes. (Case 34.) This appearance is, of course, decisive as to the source of hæmorrhage; but I am not aware whether it exists in all cases of hæmaturia from external violence. The case of George Doe occurred before I was accustomed to the use of the microscope. With regard to the purulent discharge, it is obvious that when the structure of the kidney is destroyed by suppurative inflammation, the pus coming from cavities in the disorganized gland cannot exist in the form of purulent casts. It is probable that the suppuration commences within the uriniferous tubes, and a microscopic examination *at the very commencement* of the suppurative process might detect purulent casts in the urine, as in the case of Mac Clement (p. 419); but at a later period, when an abscess is formed, this diagnostic sign must be absent.

It sometimes happens that an abscess in some neighbouring part discharges itself into the ureter or bladder. I have before (p. 5) referred to a preparation in the museum of King's College, which shows a communication between a psoas abscess and the ureter. Abscesses in the cellular tissue of the pelvis, occurring after parturition, or in other circumstances, sometimes communicate with the bladder. In these and other cases of purulent discharge with the urine, as a consequence of abscesses originating external to the urinary organs, the diagnosis must be based upon a careful consideration of the previous history, and of the seat of pain, swelling, and other attendant symptoms.

PROGNOSIS.

Suppurative inflammation of the kidney is always attended with a great degree of risk; but when the disease has been excited by external violence in a person of sound constitution, there is a possibility of recovery, if the patient's strength is sufficient to bear up against the exhausting influence of the continued purulent discharge. I once examined the body of an aged individual, in which there was a communication between the left kidney and the descending colon. The substance of the kidney had been destroyed, as it appeared, by suppurative inflammation, and the cavity of the abscess was now contracted, and partially filled with adipose tissue. The danger in such cases is, that the patient's strength will be exhausted before the kidney can be reduced to that contracted and inactive state which I have just now described.

TREATMENT.

The primary object of treatment is to *prevent* the occurrence of suppurative inflammation after the receipt of any severe injury in the region of either kidney. The patient should remain in bed for a few days, restrict himself to a very moderate diet, and avoid stimulating beverages. The bowels should be kept open by occasional doses of castor oil, and if there be much pain in the kidney, a warm bath and the abstraction of a small quantity of blood by cupping over the painful part will be useful remedies. The treatment must be continued and regulated according to the nature and urgency of the symptoms. It is very important to remember, and to impress upon the patient the fact, that the kidney may continue for many months, and even for years, to suffer from the effects of a severe blow—pain and occasional attacks of hæmaturia being the most frequent symptoms of continued suffering. (See the case of Doe, p. 441, and Collison, No. 34.) So long as these or other symptoms resulting from the injury continue, the patient must exercise a watchful care over himself. He should avoid over-fatigue, and violent exertions; in short, he should be temperate in all things; and he should especially avoid heating and stimulating articles of diet. The skin should be protected against alternations of temperature by moderately warm clothing. Counter-irritation, by the frequent application of mustard or ammonia over the kidney, may sometimes be of use; and there is, perhaps, no form of renal disease in which an issue or a seton on the loins is more likely to afford relief.

When, in spite of all our efforts, suppuration has commenced, the patient's strength must be supported by a carefully regulated, nutritious, but unstimulating diet, and by the administration of such tonic remedies as the circumstances require. Steel and quinine, either separately or in conjunction, and either with or without the mineral acids, will be useful remedies, by opposing the exhausting influence of the purulent discharge, and so perhaps enabling the patient to bear up against the disease until the suppurative process has ceased.

SECTION III.—NEPHRITIS FROM RETENTION OF URINE.

The effect upon the kidney of retention of the urine varies much in different cases, according to the nature and seat of the impediment; it differs, too, according as the obstruction occurs suddenly or gradually.

One of the most frequent causes of renal disease consequent upon retention of urine, is stricture of the urethra. In proportion to the degree and the duration of the stricture, the urinary organs behind the seat of obstruction undergo various changes of structure. The canal of the urethra, on the vesical side of the stricture, becomes dilated, and its mucous membrane is frequently inflamed so as to secrete pus. The muscular coats of the bladder become thickened, and its mucous membrane inflamed, and sometimes sacculated. The obstruction then affects the ureters, one or both of which have their canals dilated, and their walls thickened, and at length the natural cavities of the kidney—the pelvis, infundibula, and calyces—undergo the same process of dilatation, in consequence of a long-continued impediment to the escape of the urine. In some cases the kidneys have been found expanded into membranous cysts. There is a preparation of this kind in the museum of King's College. It was taken from a boy who had a valvular stricture of the urethra, which readily permitted the passage of a catheter, but prevented the escape of the urine.

It is very seldom, however, that the kidney undergoes much dilatation without the occurrence of other structural changes; and one of the most frequent consequences is inflammation of the mucous membrane of the pelvis—*Pyelitis*, as M. Rayer terms it. The mucous membrane of the dilated pelvis presents irregular patches of congestion and inflammation, and secretes a purulent fluid. The medullary cones become flattened out by the pressure of the retained urine, and the apices of the cones are frequently ulcerated. The cortical substance is expanded, and presents bulgings on the capsular surface, which correspond with the original lobes of the embryo kidney (see p. 11). The tissue which occupies the situation of the fissures between the lobes of the embryo kidney does not expand with the same facility as the glandular tissue, which consequently bulges outwards so as to form convex lobes.

In some cases there is no obvious change in the substance of the kidney beyond the alteration of form which results from mechanical distension; but in other instances inflammatory deposits occur throughout the substance of the gland. The tubules are rendered indistinct by an effusion of lymph or pus-corpuscles, which in some parts completely obliterate the normal structures, and collect into abscesses of various sizes. In other parts, where the morbid changes are less advanced, the tubes are rendered opaque by desquamated epithelium; this being probably a secondary result of the impeded escape of urine, and the consequent contamination of the blood. Both kidneys are usually affected, but often in different degrees.

SYMPTOMS AND DIAGNOSIS.

The symptoms of renal disease, consequent upon stricture of the urethra, are often obscure, being more or less masked by the diseased condition of other parts of the urinary organs. The dilated urethra behind the stricture, and the mucous membrane of the bladder, usually secrete pus, and there is no means of distinguishing this matter from the pus which is derived from the kidney. For the pus secreted by the kidney in these circumstances is not moulded in the tubes, as in the cases described in the first section of this chapter, but the suppurative process, commencing on the inflamed surface of the pelvis, as it extends deeper, destroys the tubular structures, so that there is no microscopic indication of the renal origin of the pus.

We derive as little assistance, in these cases, from chemistry as from the microscope. The urine which contains pus is generally albuminous; the coagulability of the urine by heat and nitric acid is, therefore, no indication that the kidneys are implicated, except when the degree of coagulability is out of proportion to the quantity of pus. A decidedly low specific gravity of the urine, with a scanty secretion, would be suspicious symptoms; and especially so when they are associated with any indications of uræmic poisoning, such as drowsiness, head-ache, vomiting, and a brown, dry tongue, with an excess of urea in the blood. Pain and tenderness in the region of one or both kidneys, and in the course of the ureter, are sometimes present, but they bear no proportion to the degree of structural change in the kidneys, and it sometimes happens that the first indication of serious renal disease is afforded by the occurrence of alarming symptoms of uræmic poisoning, quickly passing on to fatal typhoid collapse.

PROGNOSIS.

The prognosis is in general not unfavourable when the stricture of the urethra is one which admits of a cure. The risk of serious mischief in the kidneys is in proportion to the degree and the duration of the urethral obstruction. The timely dilatation of the urethra is often followed by the speedy cessation of all urgent and alarming symptoms.

TREATMENT.

It is obvious that the primary object of treatment in these cases is to remove the cause which impedes the free escape of urine from the bladder. This must be done by surgical means, which it is not my province to describe.

The medical treatment should be directed to the careful regulation of the diet as to quantity and quality, so as to guard against irritation of the damaged kidneys by the excretion of undigested food. The skin and bowels should be excited to carry off such excrementitious materials as have been suffered to accumulate in the blood. Dry cupping over the loins, or, in some cases, perhaps the abstraction of a small quantity of blood, may be of service. In some cases, stimulants, such as ammonia, wine, or brandy, may be required to counteract the depressing effects of uræmic poisoning.

SECTION IV. — NEPHRITIS FROM CALCULI IN THE KIDNEY.

Amongst the mechanical causes of renal disease, one of the most frequent is the presence in the kidney or ureter, of concretions formed of some of the normal or abnormal constituents of the urine.

VARIETIES OF RENAL CALCULI.

1. The most common variety of renal calculus is that which is composed of *uric acid*. Calculi of this kind are usually smooth or slightly tuberculated on the surface, and of a compact laminated tissue internally. They vary in colour from a pale yellowish fawn to reddish-brown. They differ much in size and shape, and often exist in great numbers, either in one, or more rarely in both kidneys. They may occur in persons of any age, but they are most common beyond the middle period of life. They are

especially frequent in connexion with the gouty diathesis, and in those who, from indulging freely in the use of porter or port wine, have induced a tendency to uric-acid deposits in the urine.

2. The renal calculi next in the order of frequency are those composed of *oxalate of lime*. They are usually of a dark brown colour, and have a very irregular and rugged surface; hence they are called *mulberry calculi*. The nucleus of a mulberry calculus is sometimes composed of uric acid. The mulberry calculi are much less common than those which are composed of uric acid. A patient may pass one of these calculi, and never void another, or he may pass another after an interval of several years. It is rare to find more than one mulberry calculus in the kidney after death; but in one instance Sir B. Brodie* found as many as five or six of these calculi in one kidney.

3. *Phosphatic calculi* are not of common occurrence in the kidney; and according to Dr. Prout, in almost all cases the immediate nucleus of such calculi is composed of phosphate or carbonate of lime, or a mixture of both. It is rare to find the triple phosphate of ammonia and magnesia entering largely into the composition of any renal calculus. Sir B. Brodie has met with only one instance of a renal calculus being entirely composed of the triple phosphate. But it frequently happens, when a calculus, composed either of uric acid or the oxalate of lime, has remained a

* *Lectures on the Diseases of the Urinary Organs.* Third edition. p. 225.

long time in the kidney, that its surface becomes coated over with the triple phosphate.

4. A *cystic-oxide* renal calculus is so rare an occurrence, that very little can or need be said of it. Dr. Prout suggests, that 'the plastic nature of cystic oxide, while it favours the formation of concretions, is unfavourable to their escape; for a substance of moderate size and hardness may be supposed to pass more readily through a muscular canal, than a plastic mass yielding to pressure, and capable of assuming the irregular forms of the canal itself.'

EFFECTS OF RENAL CALCULI UPON THE STRUCTURE OF THE KIDNEY.

The changes induced in the tissue of the kidney by renal calculi are modified according to the number, size, and position of the concretions. In some instances the calculi are so numerous and so large, as to encroach upon and disorganize the greater part of the glandular tissue. The kidney becomes converted into a suppurating cavity, the purulent contents of which, mixed with the smaller concretions, may continually escape through the ureter when that canal remains pervious. In some rare cases the abscess makes its way amongst the lumbar muscles, and discharges itself through an opening in the integuments of the loins; while in other instances it has burst into the abdominal cavity, or into some portion of the intestinal canal. Rayer gives an illustration of an abscess in the left kidney opening into the descending colon (pl. xix.); another, of an abscess in the right kidney communicating with the duodenum (pl. xx.); and in another plate (pl. li.), a still more rare occurrence is represented—a calculous abscess in the left kidney communicates by a fistulous opening through the diaphragm, with a bronchus in the left lung, through which, during the patient's lifetime, pus had been discharged by expectoration.

The disorganization of the kidney may, as before intimated, be a simple result of the great size or the number of concretions contained within it; but an equal destruction of the renal tissues may be occasioned by a calculus of small size passing into the ureter so as to obstruct it and prevent the escape of urine. The result of this obstruction is, first, a distension of the pelvis and infundibula, and subsequently, an expansion of the entire gland, which may at length become converted into a membranous cyst containing urine, mingled, perhaps, with serum or with pus. The cavity of the cyst is partially divided by septa which correspond with the divisions between the original lobes of the embryo kidney; and these are also indicated in the lobed exterior surface of the dilated kidney. Rayer gives an illustration of an enormous kidney of this kind (pl. xxi.) which contained 7lb. 11 oz. of a mixture of serum and urine. The canal of the ureter was obstructed by a small calculus.

In other cases the kidney is found wasted in an extreme degree, the only remnant of it being a small membranous cyst enclosing an irregularly-shaped calculus, which had been moulded in the pelvis and infundibula, or with a calculus of small size impacted in the ureter. It is in the highest degree probable that the greatly dilated and the extremely contracted conditions of the kidney belong to the same series of changes; and Sir B. Brodie* suggests the following explanation of the phenomena: 'The urine is collected in the pelvis and infundibula, the glandular structure becomes absorbed, and the secretion of urine ceases. Then the urine previously accumulated is absorbed in its turn, and the membranous cyst collapses and contracts, until at last it assumes the form of a mere capsule, in which the calculus remains imbedded. An enlarged kidney forms a tumour, which can be distinctly felt in the abdomen of a thin person. There is reason to believe that tumours having this origin occasionally disappear, and what I have just mentioned may serve to explain how this happens.'

SYMPTOMS OF RENAL CALCULI.

The symptoms of renal calculi may conveniently be considered under two heads—first, the symptoms occasioned by calculi in the kidney, and, secondly, the symptoms which attend the passage of calculi from the kidney through the ureter to the bladder.

1. *Symptoms of calculi in the kidney.*—One of the most constant signs of a renal calculus is pain more or less severe in the region of one kidney. The degree of pain varies much in different cases. In

* *Lectures on the Diseases of the Urinary Organs.* Third edition. p. 235.

some instances it is severe and constant, and accompanied with a sense of burning heat in the painful part. Sometimes there is great tenderness on pressure over the kidney, while in other instances the pain is somewhat relieved by moderate but firm pressure. One patient now under my care, who probably has a stone in the right kidney, obtains some relief from the pain which torments him when in bed, by lying on the back with his hand under the painful part.

In some cases the pain is intermitting, coming on only after an unusual amount of exercise, and in any case it is generally increased by exercise. In one case recently under my observation, which presented many of the signs of a renal calculus, and amongst others, hæmaturia, with numerous crystals of oxalate of lime in the urine, there was no pain in either kidney, but a fixed pain in one spot over the left hypochondrium. In some instances there is no complaint of pain whatever. Dr. Prout had known patients who were constantly passing renal concretions of considerable magnitude, declare that they felt no pain from them whatever. In other instances a renal concretion of small size has given rise to great pain for a long time before it escaped into the bladder. As a general rule, oxalate-of-lime concretions are attended with more pain than those which are composed of uric acid; the difference depending in part upon the roughness and irregularity of the mulberry calculi, and partly perhaps upon the nervous irritability which is commonly associated with the oxalic diathesis. There is, for the most part, more pain when a calculus is associated with a diseased condition of the kidney than when the structure of the kidney is healthy.

The pain frequently extends along the course of the ureter, and to the testicle of the same side, which is often retracted, and sometimes tender and swollen. Dr. Prout met with several instances in which pain and swelling of the testicle constituted one of the first and most prominent symptoms produced by a renal concretion. In some cases there is pain or a sense of numbness extending down the front and inside of the thigh.

It frequently happens that the pain occasioned by concretions in the kidney is attended with more or less of *nausea or vomiting*, coming on at irregular intervals, and being especially frequent after active exercise. Some patients are entirely free from these symptoms. One patient, at present under my observation, who has had symptoms of stone in the right kidney for a period of nine or ten years, does not remember to have suffered once from sickness, although the attacks of pain with hæmaturia have been frequent.

Another frequent indication of a renal calculus is the appearance of *blood in the urine*. There are few cases in which hæmaturia is not an occasional symptom; but the quantity of blood varies considerably in different instances. As a general rule, hæmorrhage is more frequent and profuse when the calculus is of the mulberry variety, in consequence, probably, of the irregular and jagged form of these concretions; but sometimes the formation of even such concretions is unattended with hæmorrhage. Active exercise, such as quick walking or running, or riding on horseback, or in a jolting carriage, is a frequent exciting cause of the hæmaturia.

2. *Symptoms attending the descent of renal calculi to the bladder.*—A calculus of small size may pass through the ureter into the bladder without giving rise to any symptoms. When, however, a concretion is so large as to distend the ureter, its passage through that canal is attended with intense suffering. There is acute pain in the region of the kidney, extending along the course of the ureter to the groin and testicle, which is frequently drawn upwards by a spasmodic contraction of the cremaster muscle. The pain is commonly attended with nausea and vomiting, a feeble pulse, pallor of the countenance and coldness of the extremities—the usual symptoms of collapse. Dr. Prout had known these attacks accompanied by syncope, and in one or two instances by epilepsy. The urine, which is passed frequently and in small quantities, is usually high coloured, and often mixed with blood. The pain and other urgent symptoms continue until the stone has entered the bladder, when the patient experiences immediate relief. The period occupied by the passage of a stone along the ureter varies from a few minutes to several hours, or even days. The parts which were the seat of acute pain remain tender for some time after the escape of the calculus; and when its descent has been protracted, the testicle often becomes acutely inflamed and swollen.

DIAGNOSIS.

With reference to the diagnosis of stone in the kidney, a few observations may be added to what has already been said of the symptoms. When the symptoms which I have before described as indicative of renal calculi are present, the diagnosis may sometimes be assisted and confirmed by observing the chemical and microscopic characters of the urine. It frequently happens that the urine of a patient who has a concretion in his kidney, presents the indications of the particular diathesis which has given rise to the calculous formation. A uric-acid calculus is indicated by highly acid urine, with uric-acid crystalline sediments, and the mulberry concretion is associated with the appearance in the urine of octohedral crystals of oxalate of lime. It is obvious, however, that the absence of crystalline sediment is no proof that the kidney does not contain a stone, since one may have existed for a considerable time, and before its presence has been revealed by the pain and other symptoms resulting from some accidental change of position, the urine may have lost the characters which it had when the concretion was being formed. It is equally obvious that a crystalline sediment in the urine is, in a vast majority of cases, unassociated with concretions in the kidney, or in any other part of the urinary organs. It appears, therefore, that only in conjunction with other signs of a renal calculus, a crystalline sediment in the urine may assist the diagnosis, and may indicate the probable nature of the concretion.

There is a class of cases in which there may sometimes be an unfounded suspicion of stone in the kidney. A patient complains of severe pain in the loins, sometimes increased by motion, attended with a scanty secretion of urine, which is passed frequently, but in small quantities, and micturition is often attended with a scalding sensation in the urethra. The urine is high coloured, very acid, and deposits an abundant sediment of uric acid and urate of ammonia. These symptoms occur in gouty and rheumatic subjects, or in those who indulge in copious libations of porter or port wine. Sometimes the immediate exciting cause of the attack is a wetting or a chill, and a consequent suppression of the perspiration. The concentrated acid urine irritates every part with which it comes in contact; there is aching pain in the kidneys, irritability of the bladder, which is intolerant of its contents, and scalding of the urethra. The lumbar pain in these cases always affects both sides equally, which it rarely does when a calculus is the cause, because it is not often that there is a concretion in both kidneys. The pain is not attended with nausea and sickness, as in cases of renal concretions, and it is quickly relieved by treatment. A few doses of a saline aperient with an antacid and a warm bath, followed by a dose of Dover's powder, with a plentiful supply of diluent drinks, will suffice for the speedy removal of the unpleasant symptoms which I have described; and the patient will soon forget his dread of what perhaps he can scarcely be persuaded was not an inflammation of his kidney.

In most cases the abnormal condition of the urine and the disordered sensations in the testicle and thigh, will serve to distinguish calculous nephralgia from colic. The diagnosis, however, is not always so easy as might be imagined. Dr. Watson* relates an instructive case, in which, on account of pain in the region of one kidney, accompanied with nausea and sickness, he suspected that a calculus had passed down the ureter. In this instance the urine had been of a clear amber colour throughout; there was no retraction of the testicle or numbness of the thigh, and the patient himself—an exceedingly intelligent surgeon—believed that his attack was colic, until the speedy escape of a calculus through the urethra convinced him of his error, and proved that Dr. Watson's opinion had been well founded.

The blood which escapes from the kidney in consequence of the presence of a calculus, is *not* moulded in the tubes, as in some instances of renal hæmorrhage from other causes. In a future chapter (chap. xi.) I shall refer at some length to the diagnosis of the various cases in which hæmaturia is a symptom.

PROGNOSIS.

It is difficult to give general rules as to the prognosis in cases of renal calculi. So long as the stone remains in the kidney, the question will be—whether it is too large to admit of its passage down the ureter; and this question can be confidently answered only after

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* *Lectures,* vol. ii. p. 564, third edition.

the stone, has actually passed, when, of course the question has lost its interest. When the symptoms of renal calculus have been long continued, there is a greater probability that the concretion may have attained a large size; but there is much uncertainty about this; and a stone may have become too large to pass down the ureter before its presence has even been suspected.

When a stone which is too large to pass the ureter becomes impacted in that canal, it leads to some of the consequences which I have before described. The immediate danger from such an accident is of course very great, and the patient may die partly from the pain which attends it, and partly from the scanty secretion of urine which results from a double duty being suddenly imposed upon the one kidney. (See *ante*, p. 64.) That obstruction of the ureter by a calculus is not always fatal we find occasionally demonstrated in the dead-house, when we meet with one kidney completely atrophied, with a calculus in its ureter, and the opposite kidney of twice the ordinary size; the hypertrophy of its tissue being a natural consequence of the double duty which it has been discharging, perhaps, for years. When the ureter becomes obstructed in this way, the safety of the patient depends on the other kidney being in a sound condition.

There is much danger of a patient being exhausted by the continued discharge which accompanies the suppurative inflammation of the kidney occasionally induced by renal calculi. Such cases, however, are not quite hopeless, for it may sometimes happen, as I have before stated (p. 452), that after the destruction of the glandular tissue the suppurative process ceases, and the kidney becomes converted into a membranous cyst, enclosing the concretion which originally excited the mischief.

With regard to the probability of there being a second calculus after the passage of one through the ureter, the risk of this is much less with an oxalate-of-lime calculus than in the case of lithic-acid concretions; the former are much more frequently single, and less liable to recur than the latter.

TREATMENT.

One of the most obvious indications for the treatment of renal calculi is, the correction of that particular diathesis which has given rise to their formation, with the view of preventing an increase in the size or number of the concretions. When the urine presents the characters of the uric-acid diathesis, it will be necessary to pay particular attention to the state of the skin and the digestive organs. Suppression of the perspiration increases the acidity of the urine, and favours the tendency to deposit uric acid. This must be guarded against by warm clothing, and particularly by flannel next the skin, and by avoiding exposure to wet and cold. In addition to this, the cutaneous transpiration may be promoted by the occasional use of the warm water or vapour bath; and daily active exercise in the open air—either walking or horse exercise—should not be neglected.

As regards the diet, one of the most important points is, that the food should be taken only in such moderate quantities as can be readily and thoroughly digested, avoiding, of course, such articles as are more than usually difficult of digestion. Wine and malt liquors must be taken only in very moderate quantities, sometimes they should be entirely avoided, and especially such as are acid or acescent. When a stimulant appears desirable, the safest, in many cases, is brandy diluted with cold water. In addition to these general means of treatment, great benefit is sometimes derived from the exhibition of alkaline medicines. Potash, either in the form of liquor potassæ, or of the carbonate, or in combination with a vegetable acid in an effervescing form, may be given in moderate quantities two or three times daily, so as to diminish the excess of acid in the urine—care being taken not to continue the administration of these or any other alkaline remedies for so long a time as to render the urine alkaline, or even neutral, for in that case we shall have done more harm than good by our treatment. It is better to avoid giving soda, on account of the tendency of uric acid to form a very insoluble compound with that base.

The calcined magnesia, or the carbonate, is a very useful antacid aperient in these cases; and when a more active purgative is required, the carbonate may be combined with the sulphate of magnesia.

In the treatment of the uric-acid diathesis, regard must always be had to the general condition of the patient. Sometimes a course of tonic medicines is the best means of removing the tendency to deposit uric acid, which results from the imperfect assimilation of the food in debilitated persons. Amongst remedies of this class, there is none more successful, as Dr. Golding Bird states, than the preparations of steel.

The general rules as to clothing, diet, and exercise, which have been before given for the management of the uric-acid diathesis, are equally applicable in the treatment of patients whose urine contains the oxalate of lime. Excessive fatigue and anxiety, which have often induced the tendency to oxalate-of-lime concretions, must be avoided as much as possible; and, regard being had to the patient's general condition, the treatment must be regulated accordingly. In some cases, when there is much pain and restlessness, an opiate at bed-time is of great service, its constipating effect being counteracted by an occasional mild aperient, such as castor oil, or compound rhubarb pill, or a few grains of compound colocynth pill with extract of henbane. When there are indications of anæmia, the preparations of steel are often of great service. Dr. Golding Bird recommends the sulphate of zinc in cases where great nervous irritability exists. It should be given, he says, 'in graduated doses, beginning with one grain, thrice a day, increasing the dose every third or fourth day, until eighteen or twenty grains are taken daily. The addition of a grain or two of ext. hyoscyami, or camphor, often enables it to be better borne.' Daily cold or tepid sponging, or the shower-bath, are very useful auxiliary means. The patient should, of course, be cautioned against the use of articles of diet, such as rhubarb and sorrel, which abound in oxalic acid, and which will increase the quantity of oxalate of lime in the urine, especially if the base of this salt be supplied by drinking hard water.

An alkalescent condition of the urine, with a tendency to deposit the phosphates, is almost invariably associated with more or less of general debility and depression, and the remedies required are such as will tend to restore the patient's enfeebled powers. Dr. Watson thus briefly, but graphically, describes the appropriate treatment of these cases. 'You must cautiously abstain from all drugs or measures that are calculated to lower the vital powers; from saline draughts and alkalies of every kind; from mercury and colchicum; from bleeding, and even from active purgation, or you will add to the patient's dangerous weakness, and promote the more abundant deposit of the phosphates. But you may do more than abstain from what is hurtful: you may counteract the alkalescent tendency by a generous diet, and by the exhibition of tonic medicines; bark, wine, and acids: the muriatic acid, or the nitric, or both together, may be given in such cases with vast advantage sometimes. Opium is also a remedy to be employed in this form of disease. No single drug, probably, has so much power in rendering alkaline urine acid, as opium, and it is indicated for other reasons—it composes the nervous anxiety to which these patients are mostly a prey. Mental relaxation, freedom from care, the relinquishing of all exhausting habits and pursuits—these, too, are points of vast importance, whenever they are attainable.'

I have nothing to add to the preceding directions for the treatment of phosphatic deposits, except that the muriated tincture of iron, either with or without the addition of a few drops of muriatic acid, is, according to my experience, a very valuable remedy in this class of cases. This preparation of iron may be given in doses of from ten to twenty drops, with the same quantity of tincture of henbane; or it may be given in infusion of calumba, with the addition of syrup of orange. It is best taken soon after a meal.*

When the presence of a concretion in the kidney is clearly indicated by the symptoms which have been before described, it has sometimes been recommended that attempts should be made to dislodge it by active exercise, and the use of diuretic medicines. It appears to me, however, that the risk of mischief from such measures so far outweighs the probability of any real benefit, that I should never advise their adoption. The patient should rather be cautioned against such kinds of exercise as may tend to irritate and inflame the kidney. There can seldom, however, be any objection to the copious drinking of some simple diluent liquids,

* For a full and complete history of the chemical pathology and treatment of the various forms of saline or crystalline urinary deposits, reference may be made to the well-known treatises by Dr. Golding Bird, Dr. Owen Rees, and the late Dr. Prout, as well as to the various papers, and the work on *Animal Chemistry*, by Dr. Bence Jones, to which allusion was made in the first chapter of this treatise.

which, by increasing the flow of urine through the kidneys, may favour the displacement of the concretion.

When, from any cause, symptoms of renal irritation or inflammation arise, they may be subdued by the same measures as have been before indicated for the treatment of nephritis after blows on the loins. (See p. 443.) Rest in bed, cupping on the loins, followed by warm fomentations, or an occasional warm bath; food in small quantities, and of the most digestible kind; an entire abstinence from alcoholic drinks, and other diuretic stimulants; the regulation of the bowels by such aperient medicines as are least likely to irritate the kidneys, castor oil being, perhaps, the safest which can be chosen—these means of cure, or some of them, according to the nature and urgency of the symptoms, will be called for when nephritis results from the irritation of a calculus.

When the symptoms of renal irritation are long continued, and attended with much pain, relief is sometimes afforded by an issue or a seton in the loins. Sir B. Brodie has found this remedy eminently useful in those cases in which abscess of the kidney has been occasioned by a calculus in the kidney. In other cases the pain may be relieved by the application of a belladonna plaster over the loins.

Although in the earlier stage of inflammation excited by calculi it is better to avoid alcoholic stimulants on account of their diuretic and irritant action upon the kidneys, yet it may be quite necessary to give such stimulants, as well as tonics, when suppuration has occurred, and when the patient's life is endangered by the exhausting and depressing influence of his malady.

When a calculus is passing down the ureter, the chief object of treatment is the relief of the severe pain which attends the process; one of the most efficient means of doing this is the warm bath, in which the patient may remain for half an hour or more, according to circumstances. The faintness which it sometimes induces is very beneficial, by relaxing the spasm of the ureter, and so favouring the onward passage of the stone. Much relief is sometimes afforded by the injection of warm water into the bowel. Opium may be given in large doses when the pain is very severe; and when, by frequent vomiting, the medicine is quickly ejected from the stomach, it may with great advantage be given by injection with warm water per anum. Drinking plentifully of some simple liquids may sometimes be useful, by causing a rapid accumulation of urine behind the stone, and so aiding its propulsion. In cases of protracted suffering from renal calculi, Dr. Prout had known the greatest relief from the intolerable burning sensation of which patients sometimes complain, by the application of pounded ice to the region of the kidney. He considered, however, that the application of hot fomentations, as hot as they can be borne, is the safest expedient, and one which seldom fails to give temporary relief.

CHAPTER IX.

TUBERCULAR OR SCROFULOUS DISEASE OF THE KIDNEY.

THIS somewhat rare form of disease is well represented in M. Rayer's plates (pl. 42, 43, and 44); and I am indebted to the same authority for many of the facts contained in the following history.

A tubercular deposit in the cortical substance of the kidney may occur in the form of separate masses, varying in size from a pin's head to a hazel nut, or it may be infiltrated into the renal tissues so as to form a continuous mass, involving one or more lobes of the gland. The smaller deposits are usually very defined, having a more or less rounded form, and they are readily detached from the surrounding tissues. On a microscopic examination, these tubercular masses are found to be composed of a finely-granular matter, with very slight appearances of cells, or any organized morbid product. In the midst of this amorphous matter some fragments of the uriniferous tubes may generally be seen, and occasionally a portion of tube is found to be filled with the same amorphous finely-granular matter which constitutes the mass of the tubercle. The line of demarcation between the tubercular deposit and the surrounding tissues is, as already mentioned, very abrupt, so that it is difficult to trace the transition from the normal to the diseased state. It is seldom that the tubes round the tubercular deposit present a perfectly healthy appearance on a microscopic examination. The epithelium is usually more or less opaque and granular, and occasionally there are some appearances of desquamation; and in the midst of tubes in this condition there may sometimes be seen one filled with the amorphous granular matter before described. It is probable, therefore, that the amorphous tubercular material is first deposited in the tubes, and that its deposition quickly leads to the complete disorganization of the tissues. The tubercles are usually firm when first deposited; at a subsequent period they frequently become softened, but they rarely contain any well-defined pus-corpuscles, and thus they are distinguished, as M. Rayer remarks, from points of ordinary suppuration.

As the deposit increases, the tubercles become confluent, and form large masses. These are sometimes exactly limited by one of the original lobular divisions of the kidney. The larger masses frequently soften, and discharge themselves into the pelvis of the kidney; and in this way the whole glandular substance is sometimes destroyed, leaving an irregular cavity, which is incompletely divided into several compartments by septa formed of the condensed and thickened areolar tissue, which occupies the situation of the original fissures between the lobes in the embryo kidney. (See p. 11.)

The tubercular deposit occurs in the medullary cones either in the form of small grains or of large masses. Very frequently the granular deposits are arranged in a linear series, like a row of beads. In the advanced stages of the disease, the medullary cones are more or less completely destroyed, either by ulceration consequent upon softening of the tubercular matter, or by pressure resulting from an impeded escape of urine through the thickened and obstructed ureter. The disease commonly extends from the mucous membrane of the calyces and pelvis into the ureter; the walls of which become much thickened, its mucous surface irregularly ulcerated, and its canal sometimes dilated in consequence of obstruction near its lower end; but frequently it is narrowed throughout, so that the urine and tubercular matter being retained in the cavities of the kidney, produce great dilatation and enlargement of the organ, which may be recognised on percussion and palpation of the abdomen. Rayer found that in nine cases out of sixteen, the volume of the kidney was not sensibly increased by a tubercular deposit; and in two instances out of the same number of cases, the size of the kidney was less than normal. The increase of size was greatest, in the cases just now referred to, which were attended by an impeded escape of urine and morbid products from the kidney.

The tubercular disease sometimes extends from the ureter to the mucous membrane of the bladder, and occasionally, even when the mucous membrane of the bladder is but little affected, the disease is found in the urethra, the prostate, and the vesiculæ seminales.

Tubercular disease of the kidney is much more common in the middle periods of life than in persons of advanced age. M. Rayer has met with the disease only twice in infants; and he appears to doubt the accuracy of the statement, that young children are more subject to this form of disease than adults. With regard to the frequency with which each part of the kidney is affected, in sixteen cases of the disease occurring in adults, the tubercular deposit was found in the cortical substance sixteen times; in the medullary portion fifteen times; and thirteen times in the mucous membrane of the pelvis and ureter.

In only six of the sixteen cases was the disease found to co-exist in both kidneys, while in the remaining ten cases it was confined to one kidney, and in seven of these cases it was the left kidney which was affected.

At a meeting of the Pathological Society, in May, 1849, Dr. Bence Jones exhibited two kidneys, one of which (the right) was disorganized by a tubercular deposit, and the other was affected by fatty degeneration in a great degree. Both kidneys were from a girl, seventeen years of age, of a highly scrofulous aspect, and very stunted growth.*

When tubercular disease exists in the kidney, the lungs are almost always found to be affected with the same disease; and, in most cases, other parts of the genito-urinary organs are in a similar morbid condition—the bladder, the urethra, the testicles, the vas-deferens, the vesiculæ seminales, and the prostate in the male, the uterus and the Fallopian tubes in the

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* *Proceedings of the Pathological Society of London.* 1848—1849.

female; frequently, too, the lumbar and mesenteric glands, and the mucous membrane of the intestines, are involved in the disease.

Symptoms and Diagnosis.—When a tubercular deposit is confined to the substance of the kidney, it is difficult to detect the disease during life. The urine may be albuminous, and there may be some dull pains or tenderness in the lumbar region; but these signs, even occurring in a person of the scrofulous diathesis, would be insufficient for a confident diagnosis.

When the tubercular matter, after undergoing a process of softening, escapes from the substance of the kidney into the ureter, its appearance in the urine renders the diagnosis much easier. The microscopic characters of the tubercular matter are not very definite, but the scrofulous nature of the disease may be suspected when the urine deposits a sediment which contains a mixture of pus-corpuscles and sometimes of blood, with a considerable quantity of amorphous granular organic matter, insoluble in acetic acid. The quantity of amorphous granular matter varies much on different days, and even at different periods of the same day. When the disease affects the bladder, shreds of mucous membrane, infiltrated with tubercular matter, are frequently visible by the naked eye, and in the same circumstances there is more or less of pain and tenderness in the region of the bladder, frequent and painful micturition, and other symptoms of cystitis. When the symptoms before mentioned are associated with the signs of tubercular disease in other organs—as, for example, in the lungs or testicle—there can be little doubt as to the existence of tubercular disease of the kidney and bladder. The diagnosis will be confirmed, when, in consequence of the accumulation of urine in the pelvis and calyces, the kidney becomes dilated so as to form a large multilocular pouch, lined with tubercular matter, which may be detected by palpation and percussion of the abdomen. M. Rayer observes, that scrofulous disease of the vertebræ has repeatedly been found associated with this tubercular disease of the kidneys; and he suggests that the existence of this form of renal disease would be rendered probable by the occurrence of a urinary sediment similar to that before described in the case of a patient suffering from scrofulous caries of the vertebræ. The preparation to which I have before referred (p. 5), affords an illustration of one source of error in such cases—viz., the opening of a psoas abscess into the ureter.

Causes.—As to the causes of tubercular disease of the kidney, it is unnecessary to say more than that the disease is one of the less common consequences of the tubercular or scrofulous diathesis.

Prognosis.—The prognosis must obviously be unfavourable, since the renal disease—itself a serious malady—is rarely unassociated with tubercular disease of other organs, and especially of the lungs. The absence of any such serious complication would afford ground for a less unfavourable prognosis.

Treatment.—The object of treatment is to support the patient's strength, and to lessen the morbid tendency, by a nutritious diet adapted to the general condition and to the digestive powers of the patient, and by the administration of steel, iodine, or cod-liver oil. For the relief of pain, the warm bath and the cautious administration of opium will often be useful. It may sometimes be right to seek for benefit by a change of air and climate; but this will depend upon the stage of the disease and the nature of the complications. Since a cure is scarcely possible, we must be careful not to aggravate the sufferings of our patient by any injudicious treatment.

CHAPTER X.

CANCER OF THE KIDNEY.

CANCER is one of the rarest forms of renal disease. In a certain number of cases it has been found to affect the kidneys alone, but in the greater number of instances cancer of the kidney is associated with a similar disease in various other parts—in the lumbar and mesenteric glands, the liver, the lungs, &c. In some cases M. Rayer has found that the cancer has extended from some contiguous organ to the kidney; from the liver to the right kidney, and from the descending colon or the contiguous portion of the stomach to the left kidney.

With respect to the form of cancer, the encephaloid variety is by far the most frequent in the kidney. Dr. Walshe* has collected from various sources forty examples of renal cancer. In thirty-six of these cases the anatomical state is described with considerable accuracy.

'In thirty-one of these, pure encephaloid, or one of its varieties, was the species of cancer observed; scirrhus in five only, two of them of doubtful character; while colloid did not in any instance occur in this situation.' The hæmatoid variety of encephaloid

* *The Nature and Treatment of Cancer.* By Walter Hayle Walshe, M.D.

cancer is more frequent in the kidney than in most other internal organs; blood in variable proportions being mingled with the encephaloid matter. Melanotic discoloration of the cancerous masses is rarely met with in the kidney.

Cancerous degeneration, like most other forms of renal disease, almost always commences in the cortical substance, but it frequently extends to the medullary cones, and sometimes to the walls of the pelvis and to the ureters. The encephaloid masses, which are usually developed in the substance, or on the surface of the cortical portion, have at first the consistence of the renal tissue in which they are formed. At a later period they become as soft as brain, and finally, they sometimes break down into a semi-liquid pulp.

The cortical substance in the intervals of the cancerous tumours is sometimes healthy, at other times it is more or less injected or inflamed, and occasionally it contains purulent deposits.

When the cancerous tumours are few in number and of small size, the volume of the kidney may not be sensibly increased; but in some instances the cancerous growths attain to enormous dimensions, so as to distend the abdominal cavity.

The first part of the *Proceedings of the Pathological Society of London* (p. 119) contains a report of the case of a child who died with cancer of the kidneys at the age of thirteen months, and after death the weight of the two kidneys was found to be five pounds.

In this case the surface of the kidneys was smooth and even, but in most instances it is nodulated with projections varying in size from a nut to an orange. Sometimes the tumours are collected near the convex border of the kidney, and in two of Rayer's cases they were confined to the upper half of the organ while the lower was quite free. Occasionally they project into the cavity of the pelvis.

When the entire kidney is the seat of the cancerous deposit the form of the organ is often much changed, and nearly all trace of its original structure is destroyed. The softened cancerous masses sometimes contain cavities filled with a mixture of cancerous matter and altered blood, which occasionally escapes with the urine by one or more openings communicating with the pelvis.

The lymphatic glands in the hilum of the kidney and in the contiguous parts often share in the cancerous degeneration which affects the substance of the organ. In some instances the renal veins and even the inferior cava are filled with fibrinous coagula, which are sometimes mixed with matters having the appearance of the encephaloid deposit in the kidney.

In thirty-five of the forty cases of renal cancer collected by Dr. Walshe, the disease affected both organs sixteen times; the right alone thirteen times, the left alone six.

The ages of thirty-one of Dr. Walshe's cases were as follow:—

Age.	No. of Cases.	Age.	No. of Cases.
0 to 1	1	30 to 39	3
1 — 2	1	40 — 49	1
2 — 9	0	50 — 59	10
10 — 19	1	60 — 69	9
20 — 29	3	70 — 79	2

It appears from this table, that while no period of life is exempt from cancer, persons of advanced years are much the most liable to the disease.

The disease is more common in males than in females. Of the forty cases collected by Dr. Walshe, twenty-four occurred in males and sixteen in females.

SYMPTOMS.

Cancer of the kidney in its early stage is sometimes latent, or attended with few and insignificant symptoms. There is sometimes deep pain, constant and more or less acute, in the region of one or both kidneys. This symptom is common to various forms of renal disease, and it may exist without any structural change in the kidney.

As the cancerous disease advances, the volume of the kidney at length increases so as to form a solid tumour, the surface of which is frequently irregular, and it may be felt through the abdominal walls.

Another symptom of renal cancer is hæmaturia. The quantity of blood mingled with the urine is sometimes small, but occasionally abundant, in which case it may coagulate in the ureter and bladder so as to impede the escape of the urine. The hæmaturia is rarely constant, but often ceases for a time, either in consequence of the actual cessation of the hæmorrhage, or as a result of coagula preventing the escape of the bloody urine. The urine is sometimes albuminous, even when it contains no blood. Dr. Christison*

* *On Granular Degeneration of the Kidneys*, p. 40.

once observed this in connexion with cerebriform degeneration of the kidneys. The urine in the advanced stages of the disease is often deep coloured and fœtid, and occasionally it contains pus and encephaloid pulp.

According to Rayer, retraction of the testicle is rarely observed in connexion with renal cancer.

The digestive organs are usually more or less disordered. There is loss of appetite, with flatulent distension of the stomach and bowels, and occasionally nausea and vomiting.

In the advanced stages of the disease the skin assumes the pale yellow tint which characterizes the cancerous cachexia; there is progressive emaciation, and often œdema of the legs, which may, as Rayer suggests, be directly occasioned by fibrinous coagula in the renal veins and in the inferior cava, or it may result from the cancerous cachexia and the continued hæmaturia; and these conditions may also induce the general dropsy which Rayer has occasionally observed in connexion with cancer of the kidney.

DIAGNOSIS.

In the early stage of the disease the diagnosis of renal cancer is very difficult and uncertain; but it becomes less so when the disease is so far advanced as to cause hæmaturia and a perceptible tumour. So far as I know, there is no means of distinguishing the blood which escapes from a cancerous kidney from that which is occasioned by a renal calculus. In cases of renal hæmorrhage from the latter cause, the blood is not moulded in the tubes; but with regard to the hæmaturia in connexion with renal cancer, as I have never had the opportunity of making a microscopic examination of such urine, I am unable to say whether the blood presents the form of tube-casts or not.* The materials associated with the blood might assist in the diagnosis: the microscopic characters of the encephaloid pulp, when present, would be decisive as to the cancerous nature of the disease, and crystals of oxalate of lime or uric acid would indicate the probability of a calculus being the cause of the hæmorrhage. The general history of the patient, and the associated symptoms, must, of course, be carefully considered. The existence of cancer in any other organ, the previous removal of a cancerous tumour, or the signs of the cancerous cachexia, would render it very probable that a continued pain in the region of one or both kidneys has its origin in renal cancer; the probability would be increased by the occurrence of hæmaturia, and still more by the appearance of a tumour in the region of either kidney.

Cancerous tumours of the kidney have frequently been mistaken for tumours of other organs, and for diseases of a different kind in the kidney itself. The two points to be determined, therefore, are—1st, the seat of the tumour; and 2nd, its nature.

I recently heard of a case in which an enormous cancerous tumour of one kidney was mistaken for ovarian dropsy, for the removal of which an operation

* See the succeeding chapter, on the diagnosis of hæmaturia.

was contemplated, but, happily, not performed. The nature of the tumour was not discovered until after death. The general signs of a renal tumour are, that it is situated in the lumbar region, and that, when large, it extends thence into the surrounding regions of the abdomen. As the intestine usually lies in front of the kidney, percussion yields a tympanitic sound in that position, but there is no resonant space between the spine and the tumour. A renal tumour is not moveable. There is usually a space between the ribs and an enlarged kidney, which may be recognised by percussion and palpation; and in most cases there is an interval between the kidney and the iliac fossa. Besides the situation and the relations of a renal tumour, there are the signs resulting from an altered condition of the urine, which may contain blood or other morbid products, and these signs are often the greatest help in the formation of a diagnosis.

A renal tumour on the right side has been mistaken for enlargement of the liver; an error which, as Rayer suggests, is more likely to occur when there are morbid adhesions between the liver and an enlarged kidney, because in this case there might be no interval between the ribs and the kidney. It is to be remembered, that an enlarged liver often rises very high in the chest, which the kidney never does; the lower edge of the liver is usually well defined, unless when there is a great degree of ascites, which would itself indicate hepatic disease, as would a yellow tint in the *conjunctiva*. The sallow skin which accompanies the cancerous cachexia might be mistaken for jaundice, and the bile in the urine of a jaundiced patient for blood, and both mistakes might lead to errors in diagnosis. The blood-corpuscles may be recognised with the microscope; and the urine which contains blood is coagulable by heat and nitric acid. The presence of bile in urine may be detected by adding a drop or two of nitric acid to a small quantity of the urine on a white plate. The liquid passes through various shades of colour—'pale green, violet, pink, and yellow—the colour rapidly changing as the acid mixes with the urine.'* An enlarged spleen might be mistaken for a tumour of the left kidney; but it extends more forwards and upwards into the chest, in proportion to its backward direction, than a renal tumour; its anterior notched edge is often well defined and characteristic, and the tumour may sometimes be traced to its origin in intermittent fever, or in impeded circulation through the heart, lungs, or liver. An ovarian tumour is distinguished from a renal swelling by its origin low down, by its connexion with the uterus, as indicated by a vaginal examination, its mobility, its elasticity and fluctuation, the dulness over the front of the tumour, with a resonant space on either side behind. In the case before referred to (p. 476), the renal swellings, which commenced distinctly on each side, finally coalesced, and presented no definite boundaries. Such a swelling in an adult female would have many of the appearances of ovarian dropsy, and would require much care in diagnosis.

When the question as to the renal origin of a

* See Bowman's *Medical Chemistry*, p. 46.

tumour has been decided, we have still to determine the nature of the enlargement. The cancerous nature of the tumour would be rendered probable by its rapid growth, by its uneven, nodulated surface, by hæmaturia, and occasionally, perhaps, by the appearance of encephaloid pulp in the urine, by the existence of cancer in other organs, by the appearance of the cancerous cachexia, and by the absence of those signs which indicate the existence of enlargement of the kidney from other causes. The diseases of the kidney, not cancerous, which may lead to great enlargement of the organ, are tubercular disease, dilatation of the kidney from an impeded escape of the urine consequent upon calculi in the ureter or stricture of the urethra, and acephalocysts in the kidney.

Tubercular disease of the kidney is almost invariably associated with tubercles in the lungs. *Calculous disease* is indicated by some of the signs before described (chap. viii., sec. iv.) of the calculous diathesis, by the abundant purulent discharge with which it is often accompanied, and the fluctuation sometimes perceptible in the tumour. When the dilatation of the kidney is a consequence of *stricture of the urethra*, the existence of the stricture is an important fact; the feel of the tumour is the same as in cases of calculous disease. In all these cases the surface of the kidney is lobed, but not irregularly nodulated, as in cases of cancerous disease. *Acephalocyst hydatids* are very rare in the human kidney, and the only certain sign of their existence is the escape of some of the hydatids with the urine.

PROGNOSIS.

The prognosis in cases of renal cancer is most unfavourable, for not only is the disease a fatal one, but it runs its course very rapidly. Dr. Walshe states that in only six of the forty cases collected by him, in which the renal disease was uncomplicated, was the duration of the symptoms noted. 'The mean duration of these cases was eight months; two months and a half less than that of encephaloid disease of all organs indiscriminately.'

TREATMENT.

The indications for treatment are—1st, to support the patient's strength by nourishing food and such tonic medicines as are found to agree best with the stomach; the preparations of steel are amongst the most valuable of these: 2nd, To relieve pain by the occasional use of opiates internally, by a belladonna plaster on the loins, by warm baths or fomentations, sometimes by moderate counter-irritation, but rarely, if ever, by local bleeding, on account of the rapid deterioration of the blood which the disease occasions: 3rd, To check hæmorrhage by the internal use of astringents, such as gallic acid or the tincture of sesquichloride of iron, and the application of pounded ice in a bladder over the bleeding kidney may sometimes be of use.

The accumulation of fibrinous clots in the bladder or urethra, and the consequent retention of urine, may call for the introduction of a catheter and the use of injections for the purpose of washing out the bladder.

Chapter XI.

HÆMATURIA.

HÆMATURIA is, in a large proportion of cases, only a symptom of disease or injury in some part of the urinary organs, and as such it has frequently been mentioned in previous chapters. In some instances it is unassociated with any other evidence of disease. It is a striking symptom, which always arrests the patient's attention, and frequently excites his fears; on this account, as well as on account of its own intrinsic interest, it is important that the practitioner should be able to ascertain the source of the hæmorrhage and its pathological significance. It appears, therefore, desirable to treat of the subject separately, and to do so with especial reference to diagnosis.

Hæmaturia frequently occurs in the early stages of all the forms of renal disease which have their origin in a morbid state of the blood, and especially when the attack is acute. It is, perhaps, a more frequent result of acute desquamative nephritis than of any other amongst this class of diseases. The appearances of the urine in these cases have been fully described (p. 88), the blood-casts (fig. 27, p. 488), which indicate that the blood has been moulded in the uriniferous tubes, are mixed with epithelial casts, the result of the desquamative process, and the diagnosis is neither difficult nor doubtful. In like manner the blood-casts may be associated with each of the forms of casts which are indicative of various pathological conditions of the kidney, and they must be viewed and interpreted in connexion with these. As a general rule, however, the tendency to hæmorrhage diminishes during the progress of chronic diseases of the kidney, on account of the gradual thickening of the Malpighian capillaries which is common to all the chronic forms of renal disease (p. 231). So that, with certain limitations and cautions, the appearance of blood-casts in the urine is an indication that the disease is comparatively recent, and they are, so far, a sign of favourable import.

With reference to the occurrence of hæmaturia in connexion with cancerous diseases of the kidney, I have little to add to the remarks which I have before made upon the subject (p. 479). It is doubtful whether the microscope will assist in determining the source of the hæmorrhage, or, in other words, whether, in any of these cases, the blood occurs in the form of casts of the tubes. In some cases it is quite certain that the blood would not be moulded in the tubes, as, for instance, when a bleeding cancerous mass projects into the pelvis of the kidney. There is one phenomenon which, whenever it occurs, is, as Dr. Watson says, ' very characteristic of hæmorrhage from the kidney, or the commencement of the ureter. I mean the expulsion, with the urine, of slender cylindrical pieces of fibrine, which have evidently been moulded in the ureter, and subsequently washed down into the bladder by the descending urine.' The obstruction of the ureters in this manner, and the consequent retention of urine, are sometimes attended with much pain and vomiting. The doubt as to diagnosis in such a case will sometimes be between cancerous disease and calculi in the kidney. The general diagnostic signs of these two conditions I have already given, and I shall presently refer to the subject of hæmaturia as specially connected with the presence of calculi. In the mean time, I have to speak of certain cases in which hæmorrhage from the Malpighian capillaries is a consequence of the presence of some irritant material in the blood.

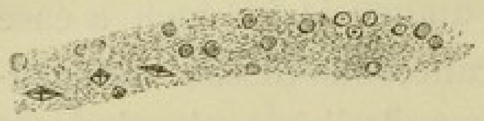
Case XXXI.

Hæmaturia after taking oil of turpentine; blood-casts of the renal tubes; no epithelium.

John Harvey, æt. 27, a porter, of temperate habits; never had dropsy or any symptom of renal disease. On the 21st of March, 1847, he took Olei terebinth, olei ricini, āā ℥ss, for tapeworm. Soon afterwards his head felt confused; he vomited once, and was purged two or three times. In about eight hours he had frequent, almost incessant, desire to pass water, passing only a few drops at a time. The water scalded him very much, and contained coagulated blood.

On the 22nd, he first came to me at the public dispensary. He said he had passed water fourteen or fifteen times during the night, and as often in the course of the morning; the pain and irritation were now less than yesterday. The urine was deeply tinged with blood, and contained a large quantity of albumen. Under the microscope numerous 'blood-casts' of the renal tubes were seen (fig. 27). A few small inflammation cells and some crystals of oxalate of lime were entangled in the casts; no epithelium; much of the blood was not moulded in the tubes. To take a mixture of sulphate and carbonate of magnesia, and to drink freely of linseed tea and barley water.

Fig. 27.



Blood-cast—some crystals of oxalate of lime are entangled in it.

On the 25th there was still a considerable quantity of blood in the urine. He generally noticed that the urine first passed was clear, and did not scald him, while the last part contained blood, and gave much pain in passing. To continue the mixture, and take every night ten grains of Dover's powder.

On the 27th the urine contained less blood and albumen. The casts of tubes were still visible, and contained, besides the blood-corpuscles, a larger proportion of inflammatory cells, about twice the size of blood-corpuscles.

On the 29th the urine had nearly the natural colour. No cloud, with heat or nitric acid. It contained a few blood and inflammation corpuscles, and a very few casts of tubes. As the bowels were confined, and he had some headache, the Dover's powder was omitted, and the mixture continued.

On the 30th the urine was clear, but some passed on the 31st was nearly black from admixture with blood. It was again albuminous. On a microscopic examination nearly all the blood was seen to have been moulded in the tubes. The casts were well defined, of a yellowish red colour, composed of *disintegrated* blood-corpuscles and fibrine. The appearance of these casts indicated that they had remained some time in the tubes before they escaped. The urine at this time contained scarcely any blood which had not been moulded in the tubes; but on previous occasions the blood had escaped rapidly before it coagulated, so that much of it did not present that evidence of its having come from the renal tubes, which is afforded by its existence in the form of cylindrical moulds.

The urine contained no epithelium; oxalate of lime was still present.

On the 6th of April, the urine was pale, free from blood and albumen, but it still contained oxalate of lime.

The preceding case is sufficiently simple and intelligible. The turpentine had been absorbed into the blood, and in its passage through the kidneys had irritated the Malpighian capillaries, which became ruptured and allowed their contents to escape. It will be seen that there was no evidence of epithelial desquamation, and it is not unlikely that the turpentine escaped through the ruptured Malpighian capillaries without reaching the gland-cells through the inter-tubular capillaries, although the absence of desquamation is not conclusive as to this point.* (See p. 355.) It is important to observe, that while the hæmorrhage was rapid, much of the blood escaped from the kidneys before it coagulated, and, consequently, was not moulded in the tubes. Still, however, there were blood-casts sufficient to show that some of the blood had come from the uriniferous tubes, and that all had probably the same source. The blood, which remained a longer time in the kidney, had all been moulded in the tubes before it escaped. The same phenomena were observed in the following case.

* I have never made a microscopic examination of bloody urine occasioned by cantharides, either applied to the skin or taken into the stomach. The appearances would probably be essentially the same as those above described in the urine of Harvey.

Case XXXII.

Hæmaturia sudden, and of short duration; blood-casts of tubes; the urine, during the hæmorrhage, having a peculiar smell of rotten parsnips.

A physician, æt. 37, with an hereditary tendency to disease of the kidney; his grandfather having died of calculus of the kidney after many years of acute suffering, and his father having been for many years a sufferer from irritable bladder and tic doloureux, which are evidently connected; has himself suffered for some years from irritable bladder, and a very variable state of the urine. On Sunday morning, June 27th, at three-quarters past ten A.M., he passed about an ounce of urine tinged with blood, and again at one o'clock about four ounces of the same character. *This urine had a strong smell of rotten parsnips.* The urine passed on first rising in the morning, and subsequently to one o'clock, had the usual characters, and was quite free from tinge of blood. Nothing unusual had been taken at breakfast on Sunday, and the dinner on Saturday consisted of fish (soles), with the same sauce which had been repeatedly used before.

The bloody urine was passed without pain, and the only symptom referable to the kidney was a single sharp and momentary pang of pain in the back, shooting round the chest, which occurred on the Saturday night. The only symptom since the passing of the bloody urine has been a slight sense of weight in the loins. Before passing the first specimen of bloody urine, the patient had walked about three miles, and in the afternoon of the same day about the same distance, without inconvenience or suffering. General health as good as usual.

On Monday, June 28th, I received a specimen of the bloody urine passed the day before, and the preceding notes were supplied by the patient himself at a subsequent period. The urine was deeply tinged with blood, and on a microscopic examination presented numerous casts of the renal tubes (see fig. 27, p. 488); the fibrine being loosely coagulated and entangling the blood-corpuscles ; no epithelium nor any crystals. These appearances immediately reminded me of the preceding case (p. 487), in which the same condition of urine had resulted from a dose of turpentine, and I at once asked the physician who brought the urine if the patient had taken turpentine, or been blistered by cantharides. The answer was negative.

I then gave him the particulars of Harvey's case, and expressed my opinion that the hæmorrhage in his case resulted from the presence in the blood of some irritating material, which had probably been eliminated, together with the blood, from the Malpighian capillaries through the kidney-tubes; that the irritation was probably of a temporary nature, and the case not a serious one. Further, that the hæmorrhage could not have been produced by a calculus, as in that case the blood would not have been moulded in the tubes.

After I had given this opinion, I learnt that the physician whom I was then addressing was the patient who had passed the urine. The urine passed on the 28th (the day after the hæmaturia) contained no blood, and was not rendered opaque by heat or nitric acid. It contained numerous small octohedral crystals of oxalate of lime.

On the 30th the urine was again examined. It contained no crystals of the oxalate, or, if any, they were very few in number. There were a few casts, composed apparently of coagulated fibrine, with disintegrated blood-corpuscles; these had probably remained in the tubes since the 27th, when the hæmorrhage occurred, and had subsequently become loosened and washed out—an occurrence precisely similar to that noted in the case of Harvey (p. 487.) The urine was not coagulable by heat or nitric acid. There has been no recurrence of the hæmorrhage up to the present time (May, 1852).

The only explanation which can be offered of the hæmaturia in this case is, that some irritating material had been absorbed into the blood or developed therein, and that its irritant action upon the Malpighian capillaries led to the rupture of those vessels, as the oil of turpentine did in the case of Harvey. The strong smell of rotten parsnips, before mentioned, indicated an abnormal condition of the urine, and the odorous material may possibly have been the irritant, but this can be only a matter of conjecture.* It was very satisfactory to be able to assure the patient that the hæmorrhage was almost certainly not produced by a stone in the kidney or elsewhere; the fact of the blood being moulded in the tubes was a sufficient warrant for this opinion. There is no reason to suppose that the hæmorrhage was, in any way, connected with the oxalate of lime. No crystals of that salt were observed in the urine which contained the blood; and although they have been repeatedly observed in the urine since that time, there has been no recurrence of the hæmorrhage, nor is hæmaturia a recognised consequence of oxalate of lime, unless when a calculus has formed.

The following instance of hæmaturia presents some interesting features.

William Dexter, æt. 30, a market-porter, of intemperate habits, during the six months before he came under my observation had been losing his appetite, flesh, and spirits, and growing pale, in consequence of an unhappy quarrel and separation between himself and his wife. He applied at the hospital on the 9th of May,

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* Mr. Simon, in his interesting and instructive lectures on pathology, mentions the fact that the peculiar smell of some dead animals may occasionally be recognised in the motions when diarrhœa has resulted from inhaling the effluvia during dissection; and he considers this as evidence of the diarrhœa having originated in contamination of the blood by animal effluvia.

and told me, that during the preceding three weeks he had occasionally passed blood in his urine. On alternate mornings he rises soon after one, and goes to his work in the market; on the other days he remains in bed until seven or eight o'clock, and does no work. It is only on the working mornings that the urine is bloody, and even on those days the urine passed towards noon and afterwards is free from blood.

The urine which he first brought me was deeply coloured with blood, almost all of which was in the form of small blood-casts; sp. gr. 1022; moderately coagulable by heat and nitric acid, not more so than would be accounted for by the blood. The urine which was not bloody was entirely free from albumen and from all morbid products. He had no pain in the lumbar region, or elsewhere; his chief complaint was of weakness and loss of appetite, and his face was pallid.

As I could not persuade him to come into the hospital, I cautioned him against intemperance and needless exposure to cold, and ordered Tinct. ferri mur., ℳ xx.; Inf. quassiæ, ℥j., after meals, three times a day. He has continued to take this, with an occasional dose of Pil. coloc. comp., until the present time (May 29th, 1852). He is gaining strength, has more colour in his lips, and much less blood in his urine; still, however, the urine is tinged with blood on the working mornings, and each time that I have examined it I have found that the blood has been nearly all moulded in the tubes. When the urine is free from blood it contains no albumen.

The hæmaturia in this case appears to be the result of the combined influence of impoverished blood and exposure to the cold night-air; hence congestion of the kidneys and hæmorrhage from the Malpighian vessels. That the blood is of renal origin, and not dependent on a calculus, is clearly indicated by its having been moulded in the tubes. He appears to be recovering under the influence of the steel, which is restoring to the blood some of its lost colouring matter.

There can be little doubt that his recovery would be much more rapid if he could have perfect rest in the hospital, or elsewhere. Perfect rest, however, for him in the present distressed state of his mind is not attainable.

HÆMATURIA IN MALIGNANT FEVER, SCURVY AND PURPURA.

Hæmaturia is an occasional symptom in malignant fevers, and indicates a very morbid condition of the blood; it is therefore an unfavourable sign. The blood may escape from any part of the urinary organs, but it comes from the kidney more frequently than from any other source.

Fig. 9, p. 94, was drawn from the kidney of a man who died of typhus fever. There was a large quantity of blood in the urine during life, and after death nearly all the tubes of the kidney were injected with blood which had escaped from the Malpighian capillaries.

The same kind of hæmorrhage frequently occurs in connexion with purpura and scurvy, and the cause of the hæmaturia is sufficiently apparent from the associated symptoms. I have before (p. 257) alluded to the means of distinguishing the granular epithelial casts from the casts composed of disintegrated blood which sometimes appear in the urine in cases of purpura.

I observed, lately, in a case of typhus fever which was complicated with hæmaturia, that the blood in all the casts was disintegrated, in consequence, perhaps, of the blood having remained for some time in the tubes before it escaped; but there were many scattered blood-corpuscles which had probably escaped from the tubes before coagulation took place. The presence of scattered blood-corpuscles and the absence of epithelium is evidence that the granular casts are composed of disintegrated blood and not of disintegrated epithelium.

HÆMATURIA FROM CALCULI IN THE KIDNEY.

The cases of hæmaturia to which I have hitherto referred, all agree in this one particular, that they originate in an altered condition of the blood. The following is an example of a different class of cases.

Case XXXIII.

Hæmaturia; blood not moulded in the renal tubes; crystals of oxalate of lime; subsequently passage of small oxalate of lime calculi through the urethra.

Mr. Bowman sent me some urine containing blood, with a request that I would examine it and report to him the result, which was as follows:—The blood was abundant, so as to make the urine of a dark-red colour, and heat gave an abundant precipitate of albumen. *No casts of the renal tubes were visible.* There were some octohedral crystals of oxalate of lime, and a few small granular inflammation cells, probably the product of an irritated mucous membrane. The inference was, that the blood, not having been moulded in the renal tubes, had not come from the Malpighian bodies, or, in other words, it could not have come from the substance of the kidney; it might have come from the pelvis of the kidney or from the ureter or bladder, and the most probable cause of its escape from one of these parts was the irritation of a calculus. Further, the presence of oxalate of lime crystals indicated the probability of the calculus being composed of that material. The precise situation of the calculus could not, of course, be ascertained by an examination of the urine, which was the only means of investigation afforded me in this case.

Within a few days after the substance of the preceding report was communicated to Mr. Bowman, he told me that his patient had passed two small oxalate of lime calculi through the urethra.

This case affords a good illustration of the assistance obtained from a microscopic examination of the urine in the diagnosis of the various forms of hæmaturia. When the hæmorrhage results from a calculus, the symptoms will vary according to the seat of the stone. A renal calculus may exist for a long time unsuspected, but one of the most frequent signs of its presence is hæmaturia, increased by any kind of active exercise. The blood, escaping from the abraded surface of the pelvis of the kidney is, of course, not moulded in the tubes. There is sometimes pain, more or less severe, or tenderness on pressure over one kidney, some pain or numbness in the thigh, and pain or retraction of the testicle.

When the stone is passing down the ureter, the symptoms become very urgent. There is severe pain extending along the ureter, and to the testicle and thigh of the same side, frequent vomiting, flatulent distension of the bowels, frequent but scanty micturition, and hæmaturia. The last symptom may not occur until after the sudden cessation of the pain when the stone has entered the bladder, and left the bleeding ureter free. Then succeed the symptoms of stone in the bladder; frequent micturition, with sudden stoppage of the stream of urine, pain in the bladder and in the glans penis, occasional hæmaturia, and lastly, that decisive evidence of a calculus which the surgeon obtains by sounding the bladder.

The presence of gravel or a crystalline sediment in urine which contains blood, affords presumptive evidence as to the existence of a calculus; but too much importance must not be attached to this sign, as it may co-exist with other causes of hæmaturia;* and it is only when there appears to be no other cause for the hæmorrhage, that the presence of a crystalline sediment would lead to the supposition of a calculus.

HÆMATURIA FROM BLOWS ON THE LOINS.

Hæmaturia is not an unfrequent consequence of violent blows over the kidney, and it is remarkable that the hæmorrhage sometimes recurs again and again, at very long intervals, after the receipt of the injury. I have already (p. 441) referred to one case of this kind, which at length terminated in suppurative inflammation of the injured kidney. I had no opportunity of making a microscopic examination of the urine in that case; but about two years since I met with the following remarkable case.

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* In the case of Harvey (p. 487), oxalate-of-lime crystals were entangled in the blood-casts, but the hæmorrhage was clearly occasioned by the turpentine which the patient had swallowed.

Case XXXIV.

A violent blow over the left kidney, followed by pain, and after three years, by hæmaturia, which frequently recurs.—Blood in the form of tube-casts.

John Collison, æt. 56, a tall muscular man; has been a policeman, and about fourteen years ago he was injured in a scuffle with a mob, by falling with his back on a scraper. From this time he suffered severe pain over the left kidney, almost constant, but increased at intervals after a long walk or exposure to cold. At the end of three years, after a severe attack of pain, he first passed bloody urine; at the next micturition the urine was clear, and did not again become bloody for about seven months. Since then he has had very frequent attacks of hæmaturia. The attacks are very peculiar. They are usually excited by walking or by a chill; so that he cannot put his hands in cold water, or permit them to become chilled by exposure to the air, without suffering an attack, which commences with pain in the left kidney, extending thence to the epigastrium. He has a tendency to yawn and stretch his limbs; rigors then come on, followed by sweating; at length he passes some bloody urine, by which the pain appears to be relieved, and the attack is at an end. He has never passed sand or gravel, never suffers from sickness during the attacks, and has never had pain or numbness in the thigh or testicle.

I examined some urine which was passed on the 27th of March, 1850, after a moderately severe attack of pain. It was neutral, nearly the colour of porter, and became almost solid on the addition of nitric acid. After standing, it deposited a reddish-brown cloud, the whole supernatant liquor being coloured dark red. *It contained numerous blood-casts of the tubes;* no crystals were visible.

On the 18th of April I examined the urine, and found it clear and free from blood and albumen; it deposited a few small crystals of triple phosphate. Its specific gravity was 1014.

On the 14th of May he came to me again. He had had two attacks of hæmaturia since his last visit, one excited by putting his hands in cold water only for a minute, and the other by walking about two miles. He brought me the urine passed after the last attack, but my examination of it was entirely unsatisfactory, in consequence of decomposition having commenced. Since then I have not seen the patient. It is not unlikely that he discontinued his visits to me in consequence of my urgent remonstrance against the use of porter, a beverage which he was in the habit of drinking rather freely, and which probably helped to irritate the injured kidney.

This case is a very remarkable one; and it appears difficult to give a perfectly satisfactory explanation of it. The patient was intelligent, and appeared quite trustworthy, so that I could not doubt the truthfulness of any part of his history. He had formerly been under the care of a very able physician, who expressed an opinion that there was a stone in the left kidney; but the history of the case appears opposed to this view. I allude particularly to the absence of sand or gravel, the peculiar nature of the hæmorrhagic attacks, their evident connexion with the previous injury, the absence of vomiting, and of disordered sensations in the thigh and testicle, and lastly, the fact of the blood being moulded in the uriniferous tubes. The last-mentioned circumstance is quite inconsistent with the fact of a calculus in the pelvis or substance of the kidney giving rise to hæmorrhage from the surrounding tissues.

I believe that the kidney received an injury from the blow, from which it had not recovered; that the injury was less than in the case of George Doe, (p. 441,) who suffered first from hæmaturia, and at length from suppurative inflammation of the kidney, in consequence of a similar injury; but that in the case of Collison, the kidney had been permanently weakened, so that when, from any cause—either active exercise or a chill of the skin—an extra amount of work was imposed upon it, the effect was such as I have described—pain continuing until it was relieved by an escape of blood. It would be very interesting to watch the future progress of this case, but I have little hope of being able to do this.

I have had no opportunity of making a microscopic examination of the urine in any other case of hæmaturia occasioned by a blow on the loins, so that I am unable to say whether the blood, in such cases, is usually moulded in the uriniferous tubes, but it appears very probable that it is so.

VESICAL HÆMORRHAGE.

There is yet another class of cases in which the urine is mixed with blood, in consequence of hæmorrhage from the mucous membrane of the bladder. A not unfrequent cause of this is an abnormal condition of the urine, which occasions irritation of the bladder, and at length an escape of blood.* The following case is an instance of this.

* In a large proportion of the cases of what are called irritable bladder, the symptoms result from the irritant action of morbid urine upon the coats of the bladder. I have before (p. 438) referred to the purulent secretion from the vesical mucous membrane, which is occasionally induced by the same cause.

Case XXXV.

Urine ammoniacal, with a phosphatic sediment, from disturbed rest and an insufficiency of animal food. —Vesical hæmorrhage, the blood not being in the form of renal casts.—Speedy benefit from the use of Tinct. Ferri Sesquichl.

Sarah Hook, æt. 36, applied to me at the public dispensary in June, 1849. For many months past she had suffered much from anxiety, in consequence of the intemperate habits of her husband. She was very nervous; her sleep was disturbed by dreams and spectral illusions. She was able to obtain a sufficient quantity of nourishment, but for some weeks past had taken scarcely any animal food, in consequence of an entire loss of appetite.

About the beginning of June she first observed that the urine had a peculiar (ammoniacal) smell, it became very thick and stringy, and had a sediment, as she said, red and white mixed. She had much pain about the bladder, frequent desire to pass water, and often much pain and difficulty in doing so. On the 25th of June she first observed that the urine was mixed with blood, and on the 28th she brought some to me. It was deeply tinged with blood, *none of which was in the form of casts of the renal tubes;* the urine had an ammoniacal smell, and contained prisms of the triple phosphate, with a considerable quantity of epithelium, probably from the bladder.

On the 29th she was ordered to take Tinct. ferri mur. ℳ xx., Acid. hydrochl. D. ℳ x., Inf. quassiæ ℥i.; ter die. Pil. saponis comp. gr. v., om. nocte. Pil. aloes c. gr. x., p. r. n.

On the 4th of July she was much better, the urine contained no blood, and less of the phosphatic salts; the vesical epithelium was still abundant.

On the 7th she was improving, but still complained of some pain in the bladder, and frequent micturition. She sleeps more comfortably. To continue the medicines.

Soon after the last report I left town, and lost sight of the patient until January 8th, in the following year. She had long before discontinued her medicine. She appeared very nervous, had a distressed expression of countenance, complained, as before, of her sleep being disturbed by frightful dreams and spectral visions. There had been no return of the hæmaturia, but the urine had an ammoniacal smell, and an alkaline re-action, and contained a considerable quantity of pavement epithelium, the source of which was probably the mucous membrane of the bladder.

Ordered, Tinct. ferri mur. ♏ xx., Infusi quassiæ ℥i.; ter die. Morph. mur. gr. $\frac{1}{3}$, om. nocte.

She continued to take the medicine regularly until the 19th of February, when she was reported to be much better in every respect. Her countenance was bright and cheerful. The urine had lost its ammoniacal smell, and had a slightly acid re-action; it still contained pavement epithelium, and some scattered pus-corpuscles, the source of the latter being probably a leucorrhœal discharge, with which she has long been troubled.

There could be little doubt as to the source of the hæmorrhage in this case. There were no symptoms referable to the kidney; the blood had not the form of renal casts; the bladder was the seat of great irritation, which was sufficiently accounted for by the very unnatural condition of the urine, which doubtless led to an escape of blood from the mucous membrane. The alkaline condition of the urine is sufficiently explained by the mental anxiety, the want of sleep —'chief nourisher in life's feast'—and the very small quantity of animal food which, in consequence of almost total loss of appetite, she had been in the habit of taking. The speedy benefit derived from the mixture of steel and hydrochloric acid must be attributed to its influence in correcting the alkaline condition of the urine, and not to any specific styptic power which the muriate of iron is supposed to have.

About the same time that the preceding case occurred, another of a very similar nature presented itself at the Dispensary, in the person of a man advanced in life. The blood in the urine was very copious, *none of it being in the form of renal casts;* there was pain in the bladder, and frequent micturition, with an abundant sediment of the triple phosphate. Under the use of the Tinct. ferri sesquichl., the phosphatic deposit quickly disappeared, and the hæmorrhage ceased soon afterwards. Within a few days after he began to take the medicine, the urine had recovered its natural characters.

It sometimes happens that hæmaturia results from simple or cancerous ulceration, or fungoid disease of the bladder or prostate; occasionally, too, it is a consequence of irritation of the mucous membrane of the bladder, occasioned by stricture and retention of urine, or by stone in the bladder. The diagnosis of these cases must be based upon a consideration of the patient's history, and a careful investigation of the associated symptoms, both general and local.

A remarkable case of hæmaturia, which terminated fatally, is recorded by Dr. Prout. 'The patient had been long resident in a notoriously malarious situation. At length he became subject to hæmaturia, which, in spite of every remedy, continued more or less, if I remember rightly, for about two years. After death, a mulberry calculus was found in one of the kidneys, which was probably the immediate cause of some portion of the hæmorrhage. The greater part of the blood, however, appeared to have come from a spot, about the size of a crown-piece, in the upper and posterior part of the bladder. The surface of the organ was not apparently diseased in this spot, but the blood obviously transuded through the mucous membrane from a large plexus of veins distended with dark-coloured blood, and situated immediately behind this portion of the bladder.'

TREATMENT.

The treatment of hæmaturia must obviously vary according to the circumstances in which it occurs. When it is a symptom of acute renal disease, whether desquamative or otherwise, the general treatment required for the primary malady is that which is best calculated to arrest the hæmorrhage. (See p. 125.) I have never seen a case of acute renal disease in which the hæmaturia required special treatment. A moderate amount of hæmorrhage appears, as before suggested, to afford relief to the circulation, and is rather favourable than otherwise. In case of the hæmorrhage being excessive, the means best calculated to arrest it are, rest in bed, and the abstraction of a small quantity of blood by cupping on the loins. It can rarely, if ever, be necessary or desirable to administer any kind of astringent medicine for the purpose of arresting the hæmorrhage consequent upon acute renal disease.

The cases of hæmaturia in which astringents are most beneficial, are those which are associated with malignant disease of the urinary organs; the same remedies, too, may sometimes be useful when the hæmorrhage results from the irritation of calculi, as well as in some cases of chronic hæmaturia from other causes. One of the most valuable astringents is gallic acid, which may be given in doses of five grains, frequently repeated. It is best given in solution with mucilage. Another useful remedy for hæmaturia is the tincture of sesquichloride of iron, in doses of from ten to twenty drops in a wine-glassful of water. This medicine arrests hæmaturia by a different process in different cases. Sometimes it has a directly astringent effect upon the bleeding vessels; but in other instances, as in the two cases before mentioned (p. 501 and 503), it acts by correcting the alkaline condition of urine, which, by its irritant action upon the bladder, has excited the hæmorrhage. The oil of turpentine may sometimes be given in doses of from five to twenty minims. It should be given with caution, on account of its irritant action; for the same reason its use is admissible only in cases of passive hæmaturia, and it must not be given when there is much irritation or inflammation of the urinary organs. Its administration would probably be attended with less risk when the hæmorrhage is vesical than when it is of renal origin.

The hæmorrhage which results from the irritant action of turpentine or cantharides, is best relieved by the free use of diluents, with an occasional dose of opium to relieve pain. When either of these drugs has entered the circulation through the stomach, it may be useful to give a dose of castor oil, for the purpose of removing any of the irritant materials which may yet remain in the bowels.

In the treatment of the renal hæmorrhage occasioned by blows on the loins, or by calculi, it is important to enjoin rest in bed, and by all available means to lessen the work imposed upon the kidney. The skin should be protected from cold, and food of the most digestible kind must be taken in moderate quantities, and unmixed with diuretic or stimulating drinks.

The vesical hæmorrhage which results from the irritant action of morbid urine, or from retention of urine, is to be relieved by remedial measures directed to the removal of the cause, by such dietetic and medicinal means as are calculated to correct the morbid condition of the urine (see p. 461), and by the surgical treatment required for the removal of the stricture or other cause of the retention.

The following directions, given by Dr. Prout for the treatment of profuse vesical hæmorrhage, are important and valuable:—'When the bladder becomes distended with blood, and complete retention of urine, in consequence, takes place, recourse must be had to a large-eyed catheter, and an exhausting syringe, by the aid of which, and the occasional injection of cold water, the coagula may be broken down and removed. If the hæmorrhage be so profuse that the bladder becomes again distended with blood in a very short time, the injection of cold water into the rectum or bladder is sometimes of great use; and should these means fail, from twenty to forty grains of alum may be dissolved in each pint of water injected into the bladder—a remedy that seldom fails to check the bleeding, even when the cause is malignant disease. I have never known any unpleasant consequences follow the use of this expedient, and have seen it immediately arrest the most formidable hæmorrhage when all other means have failed, and when the bladder had repeatedly become again distended with blood almost immediately after its removal.'

INDEX.

In all but Dr. Johnson ... much ... of Cases ...

Cysts least common in extreme atrophy (P.) – p. 287. = acute Waxy degen.

Waxy degen: confounded with acute nephritis, in consequence of mistaking waxy or hyaline casts for evidence of waxy degenerat. – p. 325. 6

Deposit of waxy material also as secondary result of chronic desquam. nephritis. 329 –

Also waxy kidney at Case XIX p. 330 – is an example of the large white kidney after Scarlet fever. –

The true case of waxy quoted from Budd. Med T. Mch 29. 1851. p. 33[?]

Waxy material only secreted into convoluted tubes. 340.

Waxy changes the result of a modified secretory action, 341.

Recovery from acute – &c about 8 days against from chronic waxy dis – 398 from & 399 top.

Waxy also confounded with non-desquam. dis – see footnote to foot of p. 361.

Tubes recover after "acute waxy" – atrophy after chronic 398 – 399 –

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