were then described. The defects enumerated were those causing bad ventilation, coldness, dampness, deficient light, deficient water supply, and general atmospheric impurity.]

An unavoidable consequence of the aggregation of communities is that the atmosphere of a town should suffer deterioration. The reduction of impurities, especially smoke and fumes, is the work of municipalities, as is also the provision of open spaces and vegetation.

The facility of water supply determines the locality of settlement of a community; its growth is largely determined by the amount, and its health by the purity. The constant high-pressure system supplies the sufficiency, but the accessibility is sadly to seek, especially in ordinary vertical houses, sublet in many dwellings or tenements; and a similar observation applies to drainage.

[Experiments and observations were described showing that the healthiness of the dwelling in this country increased in proportion to the amount of daylight and sunlight admitted, and that dryness of the site and of the house were essential to a healthy dwelling.]

The main characteristics of jerry-built dwelling-houses are deficient dryness and deficient equability of temperature; popularly they are said to be cold and damp, the dampness coming through the walls, and the coldness being due to their flimsiness.

[The ill-effects of air deficiency and effluvia were then alluded to.]

It has been shown by experiments³ upon rabbits, guinea-pigs, and upon rats, which have been confirmed, that the inspiration of putrid gases predisposes the animals to the pathogenic action of even attenuated typhoid bacilli and of bacterium coli. It is probable, therefore, that the gases from drains, sewers, and other polluted sources predispose those who inhale them sufficiently, and especially newcomers, to enteric fever and to other diseases.

Ground vapours also produce ill-effects. The power of promoting growth of tubercle bacilli is particularly manifest when common wall paper is covered with condensed organic vapour from ground air.

THE EFFECTS OF CONSTRUCTION AND MISCONSTRUCTION OF DWELLINGS ON HEALTH.

The direction and width of streets and the height of houses are important points in their influence upon dwellings and health. The main object of orientation of streets is to provide the maximum of sunshine to houses, the rear as well as the front. Arnold has concluded that the orientation of streets is beyond exact control, and attention should rather be directed to limiting the height of houses in relation to the width of streets. The practical limit has been adopted that houses should not exceed in height the width of the open spaces at the front and at the rear, but as only half the space at the rear is assumed to belong to one house, the house is permitted to be raised twice the height of the width of its own rear space.

[The provisions of the London Building Acts of 1894 and 1898 were then described.]

The lines adopted for the admission of light and air to houses have passed three graduated stages. The first stage is illustrated by mediæval houses with projecting upper storeys; the second by straight-fronted existing streets; the third by the backs of more recently-erected houses with receding upper storeys.

The careful provision of external light and air demands the equally careful provision of large windows extending up to the ceiling of dwelling-rooms, and wherever it can be afforded the fixing of ventilating grates in habitable rooms. With regard to the surface of the open spaces immediately contiguous to dwelling houses, the soil in towns always becomes polluted and prejudicial to health. There are two ways in which it can be effectually dealt with, the one is by cultivation as a garden, the other is by impervious paving so levelled and drained as to be readily cleansed. It should be definitely provided that such spaces should be either regularly cultivated or permanently paved.

[Three main structural divisions of domestic buildings were described, the horizontal, as the one-storey cottage, the vertical, and the vertico-horizontal as seen in Parisian blocks, and the defects, particularly of the latter, were pointed out.]

Internal common staircases in compound dwelling-houses by want of ventilation are prejudicial to health, as they render the contained air common to all the dwellings opening upon them. It is essential that a common stairway should be external or against an outer wall and be amply ventilated at each floor level by permanent openings. The insertion of windows may secure light, but does not necessarily secure air.

It must be borne in mind that the "flat" dwellings in all cases in which the rooms are entered directly from the common stair, or in which the vestibule, lobby, or corridor is not ventilated directly from the outer air, is essentially one large space divided into smaller spaces, compartments, or rooms, and the air supply is common to all, as there is no ventilated staircase open to each room as in an ordinary house.

In new buildings the Local Government Board wisely insists upon lobbies between w.c.'s and dwellings being ventilated by permanent openings into the outer air, and upon common staircases being similarly ventilated, but the London County Council states⁴ that it has provided windows (and, it may be added, doors) to the lobbies and staircases in such buildings because of the unsightly way in which tenants attempt to block the openings. Continuous ventilation by means of permanent openings is the only method of construction of permanent value.

In order to provide for through ventilation and against back-to-back dwellings, I have on various occasions insisted that one of the conditions of construction must be that in every dwelling of more than one room the alternative rooms must be situated upon opposite sides of the building in such a manner as to secure perfilation from opposite fronts.⁵

With reference to the size of rooms in new buildings, the London County Council has adopted a minimum of 96 square feet for bedrooms and 144 square feet for living-rooms, and the latter may be taken as a maximum, with a height now of 8½ feet, formerly 9 feet. It is a mistake to make large rooms for the poorer classes, as it leads to overcrowding, the placing of more beds in the room, and the mixing of the sexes. If the same sized family that can live in one very large room live in two smaller rooms they are housed under better conditions of aëration, decency, and physical well-being. It is important also to remember that raising the age at which children remain at school, and at which they can commence to work in factories, tends to keep them at home with their parents without earning anything towards enlarging the dwelling by another room.

The minimum number of rooms in dwellings for the poorer classes is a subject⁶ upon which I entered fully at the Birmingham Health Congress, and pointed out that the differences of sex and age are the factors that render family life impossible in a single room, and that in Glasgow Dr. J. B. Russell had shown that between 1871 and 1891 the persons living in one room fell from 30.4 to 18.0 per cent. of the total population, whereas those living in two and three room dwellings rose exactly in the same proportion as those in the one room had fallen, namely, from 54.7 to 67.2 per cent. of the total population.

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THE HISTOLOGY OF THE URINARY TRACT IN ITS RELATIONSHIP TO MORBID URINARY DEPOSITS.

By G. LESLIE EASTES, M.B., B.Sc.,
Late Laboratory Director of the Clinical Research Association.

THE value of the microscope as an aid to the recognition of the pathology of various diseases is naturally greatest in those cases in which it will enable us to form a correct opinion as to the nature of the disease during life. To this end the services and the opinion of the morbid histologist are in constant demand, primarily in those diseases which

are amenable to surgical treatment. As an adjunct to bacteriological diagnosis the microscope is indispensable, but with the majority of the diseases with which the physician has to deal during life the microscope is of but little assistance. There is, however, a large class of ailments, the sufferers from which usually avail themselves of medical treatment, and it is not till the diagnosis is placed on a firm footing that the decision can be made as to whether the patient will derive more benefit from the physician or surgeon. I refer to the diseases of the urinary tract. This is a class of disease which is often obscure, owing to the frequent difficulty incurred in correctly interpreting the various symptoms presented by the case, and it is at the same time a class of diseases in which material is always available for microscopical examination.

Before any sound opinion can be offered as to the source of any abnormal elements in urinary deposits, it is essential to have a knowledge of the normal and morbid histology of the urinary tract, and to be sufficiently acquainted with the anatomy, minute and otherwise, of the different organs, essential or accessory, to the tract. It is necessary, in the first place, to consider the nature of the epithelium which lines the urinary tract from the furthestmost Malpighian body to the exterior of the meatus urinarius, and in the female subject it would be necessary to extend the investigation even further. The Malpighian capsule and its neck are lined with a flattened epithelium very similar to the endothelium of a serous cavity. The first convoluted tubule possesses an epithelium of which the individual cells are rod-like in appearance at the base with a granular-looking protoplasm towards the free edge. The descending limb of the tubule and loop of Henle are lined with clear flattened cells, while the ascending limb and second convoluted tubule revert to the type of the first portion of the tubule—namely, a granular rod-like epithelium. The junctional and collecting tubule, and the ducts of Bellini, which latter open directly into the pelvis of the kidney, have an epithelium consisting of clear cubical or columnar cells.

NEPHRITIS.

In the course of over 6,000 microscopical examinations of urine from cases of nephritis, all of which were conducted on deposits obtained by centrifugalisation, I have never been able to convince myself that I have seen the clear, flattened epithelial cells peculiar to the Malpighian corpuscles. I have, however, been able, I believe, to recognise the granular rod-like epithelium; not because it was possible to make out a rod-like appearance of the cells, but because these cells have one other peculiarity, namely, that they are polygonal with somewhat extended processes, each cell dovetailing in a complicated manner with its neighbour. Such polygonal cells of the size natural to the epithelium in question are not uncommon in cases in which the history points to acute or subacute parenchymatous or tubal nephritis. They are always coarsely granular, but this feature is not peculiar to them, as in nearly all morbid deposits tubal cells, whatever their exact source, are granular, frequently possessing a very evident and, in proportion, somewhat large nucleus. The cubical or columnar epithelium of the latter parts of the tubules is not difficult to recognise and is the kind most commonly found when renal epithelium is present. This is only what we might expect on *a priori* grounds. For the lumen of the collecting tubules is wide enough to allow of the passage of isolated cells with ease, whereas the lumen of the loop of Henle and of the collecting tubules is so small that it is a matter for surprise that the epithelium, peculiar to those situations, when shed, is able to squeeze its way through. Frequently, however, the tubules become denuded more or less completely of their epithelium, and it is in just those diseases in which this is known to occur that the granular rod-like epithelium is most frequently found. Thus it is found in the later stages of tubal nephritis, when the kidney has passed into the stage of "large white" or "small red," and when the tubules are denuded of their lining.

CANCER OF THE KIDNEY.

I have but little evidence to offer, for I have examined very few specimens of urine from carcinomatous kidneys. The disease is fortunately rare, and, when present, the symptoms

are usually so marked as to require little corroborative evidence. Fig. 1 is a drawing which I made from a deposit

Fig. 1.—Epithelium from a case of carcinoma of kidney. A few red blood discs are shown.

in a case of renal carcinoma. It is typical of what may be detected. There was an abundance of renal epithelium. It could hardly be mistaken for epithelium from any other part of the urinary tract, on account of the size, shape, and appearance of the cells. The point which at once struck me was that the epithelial cells did not appear isolated, as is almost invariably the case in tubal nephritis, but were frequently to be found in clumps, numbering from 4 to 20 cells; the cells, as may be seen, are grouped together, with some dovetailing; they are cubical in shape, granular in appearance throughout, except for a large and evident nucleus. These appearances point to rapid proliferation, and it was, in fact, a rapidly-growing carcinoma. There were corroborative evidences in the specimen: there was much blood, which microscopically and spectroscopically showed those characteristics which are associated with blood derived from the kidney; there were a few blood casts, and there was some "renal pelvic" epithelium, which, as I shall point out later, so frequently accompanies any profound disturbance of the kidneys. Of sarcoma of the kidney, congenital cysts in the kidneys, angiomas, and the like I can say nothing.

BURIED CALCULUS.

I have examined a few cases in which, by subsequent operation, this condition was found to exist, and in a fair proportion I found indications which led me to suggest that such existed. The indications were as follows: The deposit in each case contained blood, though little, with the characteristics of renal derived blood, a few casts chiefly hyaline, and several epithelial cells, the size, shape, and appearance of which suggested an origin in the collecting tubules, but there were no epithelial casts, though blood casts were present. In every case there was much free uric acid in the deposit, and the crystals were aggregated together. Epithelium from the pelvis of the kidney was wanting or present only in very small quantity.

Chemical examination showed the presence of more albumen than was accounted for by the quantity of blood present. In each case also there was a history of tender kidney with, usually, reflected pains. The evidence may not sound convincing, in fact I quite expect to be asked why I did not think I had a case of tubal nephritis to deal with, and whether I was not entirely influenced by the history and symptoms. Perhaps I was; but yet I must say that there

was something about the deposit which did not accord with what I should expect to find in such a case, though I cannot definitely state what it was.

RENAL PELVIS.

This fortunately possesses a very distinctive epithelium (Fig. 2). The epithelium lining the whole of the renal pelvis

Fig. 2.—Renal pelvic epithelium. Upper half contains cells from the superficial layer; lower half contains cells from the deeper layers of the true mucosa.

and the upper part of the ureter belongs to the type of epithelium known as "transitional." It consists of about four layers; the layer of the free edge consists of flattened cells of a size which varies within very narrow limits, and the next one or two layers consist of cells which are characteristically spindle or pear-shaped; the lowest layer—that which abuts on the basement membrane—is composed of cells which are remarkably pleomorphic. The cells of the deeper layer are those which are most easily recognised in morbid deposits, and the commonest forms present a rounded body with granular contents and an evident nucleus. The body usually tails off rapidly into a prolongation, whose length may be twice or thrice that of the body. Some of these cells possess a prolongation at either end. These cells vary very slightly in size. They do not readily swell by imbibition, and are usually easily recognisable in deposits. They are only shed when there is extensive damage to the renal pelvis, and are most characteristic when that damage is due to mechanical causes, in particular, the existence of a calculus in the pelvis. So long as the pelvis remains uninfected, these cells are not altered by inflammatory reaction with consequent subjection of the epithelium to the action of enzymes excreted by bacteria. But the movement of a stone in the pelvis frees them from their attachment, and consequently the detection of the presence of a calculus in the renal pelvis by microscopical examination of the urinary deposit is one of the easiest and most certain diagnostic methods available. There are, of course, concomitant elements—for example, blood and casts, usually of the hyaline variety, and a slight though constant leucocytosis, not amounting to pus, with the almost invariable accompaniment of crystals (either of uric acid or of calcic oxalate) which are characteristically grouped together owing to their inclusion in mucus. For though there are no mucous glands opening into the renal pelvis, it appears practically certain that the epithelium of the renal pelvis excretes mucus. I may mention, however, that in examinations of cells from healthy pelvises obtained *post mortem* I have not found "mucus goblet cells." The question has been put to me, "Why, in cases of renal calculus are

crystals of the same nature as compose the calculus nearly always present in the urine?" The answer is probably somewhat complex. It probably depends in the first place on the fact that the cause is still operating which originally determined the deposit of those crystals in the kidney or its pelvis; secondly, possibly for the same reason that a crystal of a salt dropped into a solution saturated with that salt causes crystallisation of the contents.

Next in importance ranks pyelitis, due to causes other than calculus. Remembering the nature of the epithelium, this may usually be detected, or at least surmised, if similar cells are found to be present, together of course with pus. Pyelitis is always accompanied with some degree of ascending suppurative nephritis. Hence the deposit contains casts. The characteristics of these casts are their size and their contents. When the pyelitis is due to any other infection than tuberculosis, the urine contains numerous bacteria. I have frequently found that, in pyelitis, casts are present which are broad, and which contain innumerable bacteria, giving them a granular appearance. The casts are broad because they are derived from the ducts of Bellini and the collecting tubules. Sometimes, also, they contain pus cells. But here I must state that in my experience pus casts are rare. Perhaps it is because they are easily broken up, and as all the specimens which I examine have come through the post or from distances, they have generally been subjected to severe concussions.

In all lesions of the renal pelvis, whether due to calculus or not, I have always found more albumen than the microscopic examination seemed to warrant. Thus it is a rule that with a few casts there will be a trace of albumen; with a fair number a fair amount of albumen, and so on; while if the albumen is due to the presence of pus, the centrifuge will throw down what appears to be a larger quantity of pus than would be thought sufficient to account for the amount of albumen present. For example, a fair quantity of pus will usually be accompanied by little more than a decided trace or very small amount of albumen. But when the pus is derived from the renal pelvis, the converse holds true. The reason is probably not far to seek if we consider the anatomical relations of the renal pelvis—the adjacent large blood vessels, the rich plexus of capillaries in its submucosa, and the lymphatics issuing from the kidneys which course over it—it is evident what ample opportunities there are for leakage of serum albumen and serum globulin.

The renal pelvis may contain neoplasms, usually of the papillomatous variety. They are far from uncommon, and not infrequently become malignant. I have been able to diagnose this condition from an examination of the deposit. Groups of cells and isolated cells in large numbers accompanied by blood, the cells of a most pleomorphic character, but usually tending to a fusiform or spindle shape. Sooner or later necrotic changes supervene, with ulceration, and then the diagnosis is not so easy.

THE BLADDER.

Of the ureter I have nothing to say. The epithelium of the bladder is again of the transitional variety, but the individual elements are much larger than those of the renal pelvis (Fig. 3, p. 573), so that confusion rarely arises. In fact, it is much harder to distinguish between the vesical epithelium and that of the meatus urinarius or vulva than between vesical and "renal pelvic" epithelium.

The diseases of the bladder that cannot be diagnosed by an examination of the deposit are very few. Cystitis can be distinguished from localised ulceration, papillomatous and epitheliomatous neoplasms recognised, and vesical calculus strongly suspected, and in each case this can be done by a consideration of the character of the epithelial elements present.

In cystitis the cells are usually derived from the surface of the epithelium, and there are few of the more characteristic tailed and pear-shaped cells of the deeper layers of the mucosa. In epithelioma the cells are highly pleomorphic, smaller than in other diseases but, on the average, larger than those of the renal pelvis; they tend to come away in groups, are granular, and contain a large and evident nucleus. But the most characteristic cells are found in cases of villous growth; papillomata usually in origin, but sooner or later almost certainly becoming malignant with a marked tendency

to infiltration at the base of the growth (Fig. 4). The cells in these cases are of exceptional length, of a remarkable thinness, the greater thickness, being that of the nucleus, with other cells which are shorter and more pleomorphic.

Fig. 3.—(a) Large squamous epithelial cell from meatus, (b) leucocyte, (c) red blood corpuscles, (d) columnar tubal cell, (e) cubical tubal cell, (f) superficial cell from mucosa of renal pelvis, (g) superficial cell from mucosa of fundus of bladder.

URETHRA.

The urethra is lined with a columnar epithelium, but it is rare to see the epithelium in perfection in urinary deposits. It is only seen really well in a case in which a small calculus has been passed *per urethram*. In gonorrhoea and urethritis of septic origin there is much epithelium but it is swollen and altered in appearance. The prostate, with its numerous orifices in the urethra, might be expected to supply a fresh

Fig. 4.—Epithelium from villous tumour of bladder. epithelium, but if it does so it is unrecognisable. The only fact concerning the prostate that I have to offer is that in the

urine of lads between the ages of 14 and 20, in fact, just at the period of prostatic growth, I have frequently found clumps of clear luminous pear-shaped cells embedded in a mucoid material; similar cells or groups of cells I have never seen in urine from girls, so I am under the impression that they may be derived from the prostate.

REMARKS ON A CASE OF ELECTRIC SHOCK.

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THE rapid development and application of electricity as a motive power has come as a general boon, but, like most other conveniences, it has its drawback. Both in the generation and conduction of this electricity there is great danger. Our towns are fast becoming vast networks of wires either for telephone, telegraph, or tramcar, and we hardly seem to realise that we as pedestrians are liable to be electrocuted at any moment. That this is so has been forcibly brought before our minds by the terrible electric wire disaster which occurred in Liverpool on February 11th, and has induced me to publish the following interesting case.

I. W., aged 29, was admitted to the Southport Infirmary on February 12th, 1898, in a semi-conscious condition, with severe burns of the right hand and thigh. He was brought from the local electric works, where he had sustained the injuries.

Fig. 1.—Photograph of right hand, taken thirty-six hours after the accident.

History.—The machine from which he had received a shock was called a "rectifier," really a transformer for the purpose of converting high pressure alternating into high pressure continuous current. Transformation is brought about by means of a specially designed commutator keyed to the shaft of a small motor, the motor revolving in synchronism, and taking its driving current from the main alternator through separate conductors. The current to be "rectified" is taken direct from alternator to commutator, and then through a water-contact switch to the street lamps. This switch is protected by a wooden covering lined with insulating material, and it was from this part of the apparatus that he received the shock. A few days previous to the accident a workman had fixed a brass socket (to hold the switch plug) outside this wooden covering, using brass screws. These were apparently too long, and, passing through the cover, made contact with the high pressure terminal inside, thus causing the socket to be part of the electric circuit. The "rectifier" was not in use at the time of the accident, but the wire was charged up to the water-contact switch just mentioned.

In his right trousers pocket there was a large bunch of keys, and with his right thigh he was leaning against the brass socket, about to adjust the brushes on the motor with his right hand, when he felt the shock. In this position he was completing a circuit: from alternator to rectifier commutator, water-contact switch, brass socket, keys, right thigh, through the body to his right hand, and thence to the windings in the small motor. That the keys were the means of the conduction of the current was evident from the fact that there was a big hole burnt in the trousers, the adjacent part of the thigh charred; the keys looking as if they had just been taken out of a hot furnace. The alternator was gener-