ON THE
FUNCTIONS
OF
THE FŒTAL KIDNEY.

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IN the works of systematic writers on physiology, there is little or no positive information contained respecting the functions of the kidneys previous to birth. Haller, Blumenbach, Meckel, Bostock, and Mayo have scarcely alluded to the subject, and Magendie states that the condition of the fœtal kidneys has not been ascertained. All the glands employed in digestion have a considerable volume in the fœtus, and seem to possess some activity. The action of the others, he adds, is little known. It is not known, for example, whether the kidneys form urine, or whether this fluid passes by the urethra into the cavity of the amnion. Abernethy was of opinion that

the kidneys did not secrete urine till after birth, though some of the older writers believed the liquor amnii to be chiefly formed of the urine of the child.

The following facts seem to demonstrate that the kidneys of the human foetus, like the liver, intestinal canal, and thymus gland are in a state of activity, and perform each their respective function prior to birth.

On the 2d of January, 1835, Mr. Hay, of Osna-burgh Street, attended a patient who was delivered in the 8th month of a still-born female child. It had a double hare-lip, both its feet were clubbed, and the abdomen was so large that it passed with difficulty through the pelvis. Mr. Hay examined the body on the following day, and he found the distension of the abdomen to arise from an accumulation of fluid within the kidneys produced by an impervious state of the ureters. The right kidney, which resembled a thin cyst filled with a watery fluid, was larger than the head of the child, the left did not exceed half this bulk. Both kidneys were removed from the body without the fluid they contained having escaped, and were in that state presented to me by Mr. Hay. An opening having been made into the pelvis of the left kidney, ʒiv of a fluid resembling urine flowed out; the pelvis of the right kidney contained nine ounces of a fluid having the same appearance, which was examined by Dr. Prout.

The following letter from Dr. Prout contains an account of the chemical composition of this fluid.

“ DEAR SIR,

“ I SEND a short account of the fluid from the kidneys of a fœtus in whom the ureter was found impervious.

“ The fluid was of a deep brown colour, somewhat like diluted porter or table beer, transparent, and without any remarkable smell. Specific gravity about 10·12. Very slightly acid. On exposure to heat, it became opaque and deposited flakes of albuminous matter, which was next examined by the addition of an acid. The deposit was of a deep brown colour. The separated fluid was nearly colourless, and deposited on cooling a considerable quantity of lithic acid crystals.

“ When evaporated to dryness and treated with alcohol, that menstruum was found to take up a principle strongly acid, and which assumed readily an imperfect crystallized form. I cannot venture to give this principle a name ; it somewhat resembled the acid called amniotic, or rather allantoid, in some of its properties, but differed from it in others. The alcoholic solution gave at first faint and somewhat doubtful traces of urea ; on standing several days these became very distinct. After the albuminous matter was separated, ammonia produced a deposition of triple phosphate.

“ These results prove beyond a doubt that the fluid was of an urinary nature, and render it probable that as the liver in the fœtus secretes bile, so the kidneys secrete urine long anterior to birth; and that in a perfect state of the organs the fluid is constantly escaping through the bladder and mixing with the amniotic. This fact has been often suspected, or rather taken for granted, but has never to my knowledge been proved.

“ I send a portion of the fluid containing a deposition of lithic acid crystals.

“ Yours,

“ W. PROUT.”

“ Sackville Street,

“ January 9, 1835.”

The left kidney and ureter, which terminates in a cul de sac, form preparation No. I.

The right kidney, the bladder, and the other malformed urinary and uterine organs, form the preparation No. II.

On the 12th of February, 1835, I induced premature labour for deformed pelvis, in a patient who was six months pregnant. Thirty-two ounces of pure liquor amnii flowed through the slender silver catheter with which I punctured the fœtal membranes. It was of a straw colour, its specific gravity was 10·10. It was neither acid nor alkaline. Neither Dr. Prout nor Dr. Bostock could discover any trace

of urea or uric acid in its composition. This observation renders it probable, that at the sixth month of utero-gestation, a very small quantity if any urine is formed by the foetal kidneys, and passes into the amnion.

During the last two months I have used every exertion to procure portions of pure liquor amnii at the end of pregnancy for chemical analysis, but without success. The presence, however, of benzoic acid and urea, detected in the liquor amnii of the human subject, by Tromherz and Gaugert, proves that the urine of the foetus flows from the bladder and mixes with this fluid in the latter months. "Au reste," observes Berzelius, "la presence de cet acide precipité et de l'urée dans l'eau de l'amnios de la femme attesterait que l'urine du foetus s'écoule et se mele avec la liqueur amniotique, puisqu'il n'y a pas de liquide allantoïque special chez l'homme." *

Mr. Howship, to whom I mentioned the preceding facts, has pointed out to me the following interesting cases, contained in his valuable Treatise on the Diseases of the Urinary Organs.

In October, 1810, I was requested by my friend Dr. Merriman to open the body of a male infant, born alive in the eighth month; it languished apparently in pain, and died the same evening.

* *Traité de Chimie*, par J. J. Berzelius, traduit par M. Ellinger. Tom. VII., p. 566.

The feet were distorted, the anus imperforate, and the lower part of the abdomen occupied by a large circumscribed tumour. Dividing the parietes, this tumour protruded, white, elastic, and filled with a fluid. On each side of this tumour was a long membranous tube, large as the finger and curiously contorted; these also were evidently filled with a fluid. The central cyst was comparatively dense, firm, and opaque; the convoluted tubes much thinner and nearly transparent. The tubes terminated above, on each side the loins, in what appeared to be a mass of small hydatids; below they passed into the pelvis with the principal tumour. These parts engrossed nearly the whole cavity of the abdomen, the other viscera forming a very small proportion of its contents. These singular appearances were produced by the bladder, ureters, and kidneys having been subjected to the effects of excessive distension from accumulation of urine. The parts were removed, but before this could be done, it was found necessary to puncture the bladder, when a jet of clear limpid urine sprung forth with violence. The kidneys, ureters, bladder, and urethra were then dissected out, and the difficulty cleared up by examining the urethra. On passing a large bristle from the external orifice half an inch along the canal, it was found to be imperforate; and by introducing a fine silver probe in the opposite direction into the urethra, from the cavity of the bladder, it appeared that the canal was impervious for the extent of a quarter of an inch. The quantity of urine contained in the

bladder alone, was at least seven or eight ounces. The coats of the bladder had attained a very extraordinary degree of strength and thickness, probably to resist distension. It had, notwithstanding, given way posteriorly, where a large pouch or cyst was formed. The convoluted appearance of the ureters was as remarkable as their great increase in magnitude. The kidneys resembled a congeries of small hydatids, no larger than garden peas, loosely connected together by a cellular texture. There was no visible remains of, nor any appearance at all resembling the natural structure of the kidneys, yet, from considering the appearances, it was clear in my opinion they must have continued to secrete urine till the infant died; an event probably consequent to continued pain and irritation, from the state in which the urinary organs were found on dissection.

Dr. Ivanove, of St. Petersburg, on examining Mr. Howship's drawings of the preparation, stated that he had dissected a child born at the full time who lived 48 hours, when, the urethra being imperforate, the bladder was much, but the ureters still more, distended with urine. It was supposed by those present, that these changes might have been the result of secretion after the birth.

Sir B. Brodie informed Mr. Howship that a male foetus, of nearly the full time, was brought into the dissecting room, in whom the external orifice of the urethra was deficient in consequence of original mal-

formation. The bladder was found moderately distended with urine; the ureters were also distended with urine, as were the infundibula and pelvis of each kidney. The urine was examined by M. Brande, who found it to have the other properties of urine, but to have no uric acid in its composition*.

M. Billard has related the case of a child, who was brought into the Infirmary four days after birth, having a round soft tumour in the lumbar region. The child lived for a month, during which time it gradually became weaker and more emaciated. After death, effusion was found to have taken place into the ventricles of the brain. The right kidney consisted of a mass, as large as a goose's egg, of semi-transparent lobules, irregularly agglomerated together, forming so many small cysts, full of a white inodorous fluid. These cysts communicated with one another, and those nearest the pelvis opened into this reservoir, which was itself filled with a similar fluid. The kidney had no trace of the natural structure, and its pelvis terminated in a *cul de sac*. The ureter presented the natural appearance near the bladder, into which it opened in the usual manner, but on proceeding upward to the kidney, it assumed the form of two small impervious cords, which became further subdivided, and were applied to the kidney in the form of a goose's foot. The right kidney was

* A Practical Treatise on the most important Complaints that affect the Secretion and Excretion of the Urine. By John Howship. London, 1823, p. 376.

more than usually developed. The bladder, very little dilated, contained a turbid urine, in which were found a great number of small particles of gravel as fine as sand.

M. Billard dissected the body of a full grown male child, who was still-born on the 10th of June, 1826. The abdomen presented a round projecting tumour, like a cone, of which the umbilicus was the summit.

On opening the abdomen, the intestines were found pressed upward and backward by a large sac, which filled all the cavity. This sac was the bladder, enormously distended by a white inodorous fluid which did not render turnsol paper green. The internal orifice of the urethra was closed. On introducing a sound, it was found that the canal of the urethra gradually diminished in diameter, and at last became completely obliterated. The ureters were pervious. They opened into the bladder, but as they extended upward to the kidneys they were found greatly distended on each side; both kidneys being nearly as large as a hen's egg, presented the same lobular structure as in the preceding case. The lobules were, however, smaller, less transparent, and were partly covered with the cortical substance, but the calices and pelvis were larger and more distended than usual. A white inodorous fluid filled the vesicular lobules, which communicated with one another and opened into the pelvis.

These observations, M. Billard remarks, might serve to prove that the excretions of the fœtus, at least those of the urinary organs, are passed in the natural state out of the body, and probably deposited in the liquor amnii, for where there exists an obstacle to the passage of the urine, it flows back into its reservoirs, and distends them preternaturally, as we see in adults who are affected with stricture of the urethra or paralysis of the bladder. "This remark," M. Billard adds, "may hereafter find a place in the history of embryology."*

P. S. Since the preceding paper was presented to the Society, I have received from Dr. Wilson, physician to St. George's Hospital, the following interesting communication :—

"MY DEAR SIR,

"IN a volume of MS. 'Dissections of Morbid Parts,' registered by my late father, I find the enclosed account of what are termed 'hydatids' in the kidneys of a newly born infant, which you may perhaps consider interesting, in connexion with your late enquiries.

"Believe me, dear Sir,

"Yours faithfully,

"J. A. WILSON."

"Curzon Street, May Fair,

"March 23, 1835."

* *Traité des Maladies des Enfants.* Paris, 1833. P. 451.

*“ Copy of a MS. Dissection by the late
James Wilson, Surgeon.*

“ January, 1787. Mr. Cruikshank delivered Mrs. Tylcotte, Oxford Road, of a child, apparently well ; it, however, died in about a quarter of an hour after it was born. He opened it the day after, and found both kidneys gone entirely into hydatids, and enlarged, each of them, to the size of a man’s fist. The ureters were exceedingly convoluted and dilated, and filled with a fluid, as was the bladder prodigiously enlarged ; also the muscular fibres of it upon the stretch and exceedingly distinct : it was nearly the size of a man’s bladder.”