A MALE FŒTUS, SHOWING REPTILIAN CHARACTERS IN THE SEXUAL DUCTS.¹

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(PLATE XVI.)

BEFORE describing the condition of the sexual ducts, it may be remarked that the abnormalities in question are associated with ectopia of the urinary bladder and epispadias, and that for this reason the ducts themselves like the ureters open on a free surface.

The ectopia of the bladder is associated, moreover, with prolapse of the intestine, which has taken place immediately above the extroverted bladder. There is thus a continuous free mucous surface comprising the bladder and everted intestine.

Below and behind the convexity of the general protrusion is an empty scrotum, and the rudiment of a penis, as in an ordinary case of epispadias. There is no intestine within the pelvis, and no anus.

Kidneys.—The kidney of the left side is normal; that of the right side so remarkably elongated that its lower end reaches far into the cavity of the pelvis. The contrast will appear from the following measurements: the left from upper to lower extremity is 3·5 cm. in length; the right, 5·2 cm.; there is, nevertheless, no real excess in its volume.

The elongated kidney (which, like the left, is remarkably lobulated) has a single ureter, but the upper end of this is subdivided into three main branches, in correspondence with the abnormal figure of the organ. Each ureter opens on the free extroverted surface of the bladder at the upper angles of an area corresponding to the trigone.

Testicles.—On each side within the lower part of the abdomen there is a well-formed testicle with epididymis and vas deferens.

The vas of the left side opens into the ureter about 1·4 cm. above the external orifice of the latter. On the right side the lower end of the vas is traceable by dissection slightly beyond the corresponding ureter, lying to its inner side without opening into it; its termination becomes lost in the tissues beneath the peritoneum.

The *Müllerian ducts*, the persistence of which constitutes another of

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the valuable facts in the malformation, lie longitudinally, one on either side of the middle line. The upper end of each is bent sharply forwards and downwards upon itself for about 1.5 cm., and terminates in a blind rounded extremity. The upper end of the right is contiguous with the lower extremity of the kidney; between the upper end of the left and the corresponding kidney there intervenes a distance of 1.1 cm.

Each tube has an average diameter of 6 mm., except at the highest procurved part, where it is somewhat narrower, and from its upper point of duplicature to its lower opening the length of each is about 3 cm.

Inferiorly the ducts open on the exterior. Their openings lie to the inner side of and slightly behind the ureters; between the apertures of the persistent ducts themselves there is an interval of 1 cm.

A thick bundle of nerves extends from the hypogastric plexus to the tubes under consideration, the distribution of the nerves being chiefly to the upper part of each. Microscopic examination proves the fibres to be of the non-medullated kind.

A short way in front of the openings of the persistent Müllerian ducts are two others of lesser diameter, one on either side, which lead each into a narrow tube quite distinct from the first named. These lesser tubes lie longitudinally against the Müllerian ducts, are 1.7 cm. in length, and terminate in free blind upper extremities.

Remarks.—The prolapse of the intestine above the extroverted bladder obviously concerns the blind termination of an imperforate large intestine. The prolapse is not more than 3.2 cm. in length, but this represents all that is developed of the gut on the distal side of the umbilicus, *i.e.* of the omphalo-meseraic duct. There is an aperture on the upper aspect of the root of the prolapsus which leads into the general small intestine.

In the forty-second volume of the Pathological Society's *Transactions*, Mr. William Anderson has reported the case of an infant (the specimen of which is in St. Thomas's Hospital Museum), in whom an umbilical fistula was associated with a similarly ill-developed condition of the large intestine; the latter terminated in a free blind extremity within the abdominal cavity, and did not exceed 18 cm. in length. This prolapse of the bowel, in association with extroversion of the bladder, is a well-recognised teratological condition. I have seen it in another instance (lately added to the Hospital Museum), where the eversion concerns chiefly the upper segment of intestine above the umbilicus, and is associated with an imperforate condition, but only slight prolapse, of the lower; both segments open freely about the upper part of the extroverted bladder. In this specimen the upper prolapse has an extent of 4 cm.; the blind distal segment, of 10 cm., and within its umbilical opening lies the orifice of the appendix vermiformis; the exposed mucosa of the bladder is much thickened, and has in some parts a close-set papillary surface, whilst in others, though equally thick,

it is smooth, as in a case of extroversion I have described in the forty-fifth volume of the Pathological Society's *Transactions*; the increase in the first instance is brought about by up-growth on the papillary type, in the second by down-growth on the glandular. The double prolapse has obviously taken place through the omphalo-meseraic duct, which seems to have been involved in the fissure affecting the urinary bladder.

Forster¹ gives figures, collected from various sources, of a similar condition; in some the upper segment is prolapsed, in others it is not. He classifies them all as examples of cloaca-formation, associated with fissure of the bladder. This, however correct in a physiological sense, is misleading and erroneous in the more important morphological one.

Anatomically, there is nothing homologous with a cloaca in this complication of ectopia; the large intestine is *imperforate* at its *distal* extremity; it opens, so to speak, at the wrong end, not into a cloaca, or on a cloacal surface, but about the umbilicus in the region of the omphalo-meseraic duct.

Ahlfeld² gives similar figures. Nevertheless, what is morphologically a true cloaca may be present in cases of ectopia vesicæ, even where there is no proper anus,—if, for example, the normal developmental communication which exists between the front of the hind gut and the uro-genital sinus persist. Such a persistence is quite common in cases of imperforate rectum in the male (recto-urethral fistulæ), and occurring in conjunction with ectopia vesicæ would constitute a true cloaca.

The morphological test, in short, turns upon which end of the large intestine is open; if the distal end is absolutely closed there cannot be a cloaca, if this end opens on the mucous surface of the fissured uro-genital space or bladder, there is.

The remarkable elongation of the right kidney recalls the reptilian condition, such as is met with especially in the crocodile, in Ophidia and many Lacertilia; and it is of interest in conjunction with the corresponding reptilian disposition of the different sexual ducts to be immediately noticed. What is particularly remarkable, too, is that the elongation affects the *right* kidney, for in Ophidia the right kidney is much longer than the left. The elongated form of the kidney in reptiles is apparently related to that of the trunk; it is most pronounced in Ophidia, less so in Crocodilia and Lacertilia, whilst in Chelonia the organ is almost discoidal. So amongst Amphibia, the kidneys of the frog are not strikingly long; in the newt they measure about a fourth of the entire body length, excluding the tail.

But to come to the ducts described one on either side of the middle line. These cannot be regarded as other than persistent Müllerian ducts, which have retained, throughout, their primitive distinctness; there is nowhere any coalescence to form a uterus or vagina.

¹ "Missbildungen des Menschen," Tafel xxii.

² "Die Missbildungen des Menschen."

As I have elsewhere remarked,¹ it is a noteworthy circumstance that in cases of such persistence in the male, whether on one or both sides, the upper end of the duct is not found related to the testicle, but to the kidney, although seeing that the hydatid of Morgagni is held to represent the upper end of the Müllerian duct it would be natural to suppose that when persistent the duct would retain its relationship with the sexual gland during the descent of the latter into the scrotum.

In the present instance, the duct of the right side is contiguous with the lower end of the kidney, but on neither side is it related to the epididymis or body of the testicle. Is there an hydatid on the testicle?

It is of paramount importance in this connection to distinguish true and false hydatids.

Let it be assumed, then, that *the* hydatid projects from between the globus major of the epididymis and the body of the testicle, and that such as project from the body of the testicle itself, or from the upper surface of the globus major represent free ends of the Wolffian tubuli, what does the present specimen show?

In the paper last referred to I have pointed out that in one case, the hydatid is stated to have been absent; in another it is recorded as having been present on the side corresponding with the persistent Müllerian duct, and absent on the opposite,—there is a strong temptation to assume an erroneous transposition of “right” and “left” in this report, but so it stands, and so the specimen is figured.²

I may here state the results of a careful examination of a series (12) of foetal testicles at different ages, which I made in order to observe the disposition of the hydatids. In one, and only one, was there a second hydatid; in this case *the* hydatid was a well-formed leaf-like appendage attached to the anterior edge of the globus major; the second, quite minute and spherical, was attached to the globus just above its anterior edge and to the inner side. In the other specimens the attachment of the hydatid lay in the fissure between the globus and the summit of the body of the testicle; sometimes it was to the under aspect of the globus, but usually to the bottom of the fissure; in the smallest specimen the body of the testicle measured 5 mm. in length, the hydatid (visible only through a lens) was fixed as last mentioned.

So far now as concerns the malformation under consideration, I may describe precisely the condition met with. On both sides there are hydatids. On the right side there is one hydatid attached to the summit of the body of the testicle; a second, to the upper surface of the globus major, a short way from its extreme anterior margin; a third, more minute, to the line of junction between the body of the testicle and the globus major, there being no fissure between these parts as there usually is in the foetus.

On the left side there are two minute hydatids attached to the

¹ “Parepididymal Cyst,” *Trans. Path. Soc. London*, vol. xlii.

² Case by Chas. Rémy, *Journ. de l'anat. et physiol. etc.*, Paris, 1879.

anterior border of the globus major at the site of its adhesion with the body of the testicle, there being an absence of the usual fissure on this side as on the other. Whether *the* hydatid can be regarded as present, I do not pretend to say; the result of the explanation is ambiguous and unsatisfying.

Had there been no extroversion of the bladder, the persistent ducts would have opened into the uro-genital sinus, for their orifices lie slightly below, or, were the extroverted parts reduced, in front of, the ureters.

The complete independence and persistence of both ducts throughout their course must be regarded as a reversion to the reptilian type, where both oviducts open into a cloaca.

A similar persistence, of course, obtains in the Monotremata, Ornithorhynchus, and Echidna, but these characters are so essentially reptilian that they really relate the Monotremata to Reptilia; and the malformation under consideration is more correctly relegated to the last than to the lowest mammalian form. The justness of this will appear, also, in the disposition of the vas deferens to be presently noticed, which is one not found in Monotremata but confined to Lacertilia.

As to the blind smaller tubes by the sides of the Müllerian ducts, these, it must be inferred by analogy, represent the structures so constant in certain groups of Reptilia, namely, the anal pouches which open into the cloaca.

The right pouch in the fœtus under consideration I examined by microscopic section. The wall presents a well-marked circular and longitudinal layer of unstriped muscle fibre, and to the inner side of this a mucosa of lymphoid tissue in which lie somewhat closely set, simple tubular glands or crypts, lined with a single layer of perfectly developed columnar epithelium.

There is finally another persistent embryonic feature, still more interesting, and again explicable on the principle of atavism, or reversion to an ancestral type.

In the human subject the ureter is normally developed as a diverticulum from the Wolffian duct. On the left side this primitive relationship persists; the vas deferens opens on the surface in common with the ureter, or, to speak more accurately, the ureter stills opens into the Wolffian duct, the original continuity of the two canals not having been lost by any subsequent dislocation in the course of development.

The arrest at this stage may be explained, then, as arising in a reversion to an antecedent reptilian type; in the same way that one so explains many of the anomalies affecting the cardiac cavities. Even what is usually regarded as a strictly pathological condition, namely, the

extreme forms of hypospadias, may, it seems to me, be viewed in the same light; for among reptiles, the penis of *Chelonia* and *Crocodylia*, which is single and not paired as in *Ophidia* and *Lacertilia*, is not perforate but merely grooved on the posterior or lower aspect and attached to the anterior wall of the cloaca.

This commonness of the ureter and vas deferens is distinctly a reptilian condition. In the male of *Monotremata*, the renal and seminal ducts open separately into the cloaca, as they do also in birds and most reptiles. But among *Reptilia*, lizards present precisely the condition shown in the specimen, *i.e.* the ureter and vas combine near their lower terminations and open through a single aperture into the cloaca. I have ventured to figure this disposition from a particularly well-marked instance.

Although the rule in *Lacertilia*, it is not, however, absolutely constant; Owen¹ describes the openings as distinct in *Lacerta ocellata*.

In the male of *Amphibia* the vasa efferentia are in communication with the kidney, through which the seminal products make their way, an arrangement considerably lower than that under consideration.

FIG. 1.—The genito-urinary organs of *Varanus Salvator*. The parts are viewed from the dorsal aspect. On either side are shown a testicle with the vas deferens, and below the testicle the much subdivided kidney. Below the kidney is the straight continuation of the vas, and, to its outer side, the ureter; these unite into a common duct before opening into the cloaca (Mus., Royal Coll. Surg., London).

As to the unusual opening of the rectum above or in front of the apertures of the Müllerian or oviducts, such a position is met with in certain reptiles (*Ophidia*, *Chelonia*), but no true homology underlies the condition in the present case.

The intestinal aperture, as pointed out in the earlier part of this paper, does not correspond with such as would communicate with a cloaca; the distal end of the large intestine is blind, and the external opening concerns not this but the proximal one, the bowel being prolapsed at the umbilicus, in the neighbourhood of the omphalo-meseraic duct.

I have throughout referred the malformations in question to the reptilian type, because they are most conformed to this.

¹ "Anatomy of Vertebrates," pp. 5 and 6.

Haeckel,¹ in tracing the mammalian pedigree, after starting from the lowest invertebrate forms, at length reaches the Amphibia. From these he makes two diverging lines of descent, to the one side Mammalia, to the other, Reptilia, and, beyond Reptilia, Aves. Not a few missing links there are in the pedigree, provisionally filled in. Thus above the Amphibia he places next in succession a hypothetical series of Protamnia, in which are included the primary forms of the three higher classes of Vertebrata, namely, mammals, reptiles, birds; and yet two further hypothetical groups before the proper Reptilia and Mammalia, Pro-reptilia and Pro-mammalia. The Protamnia, Haeckel considers to have been most closely related to the existing Ornithorhynchus and Echidna.

Mammalian Pedigree, constructed after Haeckel.

Assuming this scheme to be correct, all I can suggest is, that if the reversions in the present instance are not strictly reptilian, they are related to some of these missing groups; the reptilioid characters which they disclose might have pertained to the common ancestors of modern mammals and modern reptiles; they are lower than those of the lowest existing mammals (Monotremata), yet higher than those of existing Amphibia.

At the present time, however, there is a general agreement to relate Reptilia and Mammalia more closely, if not to regard the mammalian stem as terminating at Reptilia rather than Amphibia.

One of the more remarkable recent discoveries is the well-known fact that the ova of Ornithorhynchus are provided with a shell, and hatched, like those of reptiles, outside the body. Professor H. G. Seeley, in a paper on the "Nature and Limits of Reptilian Characters in Mammalian Teeth,"² remarks that if the tooth of the Ornithorhynchus cannot be exactly paralleled in any other animal, it is at least evident that the teeth are as reptilian as the skeleton; that there are several features in which the teeth of reptiles and mammals resemble each other morphologically; and that the lower mammals emphatically approach towards reptiles in all essential characters of tooth form. Of teeth he gives six

¹ "History of Creation." 1876.

² *Proc. Roy. Soc. London*, 1888, vol. xliv.

typical characters which are regarded as mammalian,—the presence of more than one root, etc., and proceeds with the statement that no one of these is constant in the class, and its loss is in every case an approach towards a reptilian type.

The same authority has, moreover, drawn attention to the skeletal affinities between reptiles and mammals, and after noticing that the most ancient mammals exhibit resemblances to monotremes, edentates, insectivores, and apparently carnivores, observes that it is among these orders that the closest correspondence is found, bone for bone, with reptiles. Seeley, nevertheless, is driven by the force of facts very close to Haeckel's scheme, as the following quotation will show:—"The oldest known fossil representatives of both groups (*i.e.* reptiles and mammals) certainly approximate closer towards each other in all known parts of the skeleton than do the orders which survive; so that it may be a legitimate induction that, in an earlier period of geological time, the characters of both groups were so blended that there existed neither the modern reptile, which has specialised by losing mammalian attributes, nor the modern mammal, which has specialised by losing the skeletal characters which have come to be regarded as reptilian." In short, Haeckel's Protamnia are reptilian in type.

And this view of the mammalian pedigree is borne out by the remarkable facts disclosed in the malformation described, which in a certain sense confirm the conclusions not only of more recent zoology but those of palæontology.

DESCRIPTION OF PLATE XVI.

The malformations described are complicated with ectopia of the bladder and imperforate rectum, the latter being everted and prolapsed at the umbilicus. There are shown—

1. The elongation of the right kidney.
2. The persistence of both Müllerian ducts, which remain distinct throughout their course, and open near the ureters on the exterior of the extroverted parts.
3. The union of the ureter and vas deferens (on the left side), such as is met with in *Lacertilia*.
4. The presence of two independent sacs, representing anal pouches; these lie in front of the lower ends of the Müllerian ducts.

The parts are shown of the natural size.