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NUMAN, THE VETERINARIAN AND COMPARATIVE ANATOMIST OF UTRECHT: A FORGOTTEN OBSERVER ON THE FREE-MARTIN.

By D. BERRY HART, M.D., &c.,
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IN 1910, when investigating the question of the free-martin, I came on a reference in Geddes and Thomson's *Evolution of Sex** to Spiegelberg's opinion that in the free-martin "the internal organs are male but the external accessory organs are female, and there are also rudimentary female ducts." Through the courtesy of Professor J. Arthur Thomson of Aberdeen I obtained the name of the now extinct journal in which Spiegelberg's paper† was published. This proved to be an exceedingly important communication, as Spiegelberg showed for the first time that the sexual gland in the free-martin calf was a testis, and also gave a completely satisfactory description of the other rudimentary organs present. He quoted in addition from a Dutch monograph by Numan of Utrecht, translated into French by Professor Verheyen of Brussels in the *Journal vétérinaire et agricole de Belgique* for 1844.‡ This, however, gave the text and references to the plates only, but not the plates themselves. In a note it is stated, "Ce mémoire est accompagné de 23 planches: nous avons conservé tous les renvois aux planches dans la traduction, après nous être assuré que l'éditeur les fournirait indépendamment du texte hollandais." It was necessary, therefore, to get at the original Dutch monograph, and finally by advertisement a very fine quite new and uncut copy was obtained.§ It was now evident why the plates were not supplied to the Belgian journal, as the former are large quarto lithographs and the latter a folio journal, thus rendering their publication a matter of difficulty.

* Geddes and J. A. Thomson, *Evolution of Sex*, 1st edit. p. 39, Walter Scott, London, 1889.

† O. Spiegelberg, "Ueber die Verkümmerng der Genitalien bei (angeblich) verschieden geschlechtlichen Zwilling-Kälbern," *Zeitschr. für rationelle Medicin*, Henle & Pfeufer, Drt. Reihe., Bd. xi., 1861.

‡ Dr. A. Numan, "Mémoire sur les vaches stériles, connues sous le nom d'hermaphrodites, comparées a d'autres animaux portant des vices de conformation de l'appareil sexuel," traduit du Hollandais par S. Verheyen.

§ Both the *Journal vétérinaire de Belgique* and Numan's monograph are now in the library of the Royal College of Physicians, Edinburgh.

Before going on now to summarise and describe Numan's monograph I wish to give a few facts as to Numan's career, which I obtained from Professor van den Broek of Utrecht, a distinguished anatomist and comparative anatomist.

His letter is to the following effect:—

“UTRECHT, 1910.

“DEAR DR. BERRY HART.—A few days ago I met someone who could tell me something about the life of Numan; herewith I give you the information I obtained from him.

“Alexander Numan was born at Baflo, 8th December 1780; studied medicine at the University of Groningen, and took his degree as Doctor of Medicine, 14th August 1804; settled then as physician in Hougezand, a little place in the neighbourhood of Groningen. He founded with Dr. Lidth de Jeude the veterinary school in Utrecht in 1821. On 26th September he opened his lectures. On 8th July 1824 he became Director of the Veterinary School. He then held lectures on hygiene, general pathology, therapeutics, judicial veterinary art. Each morning he had to give a clinical lecture, assisted by a veterinarian who taught, under his guidance, obstetrics and surgery. On 1st March 1851 he was succeeded by Dr. Wellenbergh. He died 1st September 1852.

“He wrote, as was said to me, a very great many papers on the most different subjects of his science; if necessary I can provide you with a list of his most important papers.

“I hope that this information will be of interest to you. I regret the delay in answering your kind letter of September.

“A. J. v. d. BROEK.”

Numan was evidently a man of great ability and energy. His founding of the Utrecht Veterinary School, the many subjects he taught, and the advanced age he reached, still teaching, are proofs of exceptional mental and bodily vigour. This is also shown by the present monograph which I now go on to summarise,* taking the French translation for this purpose, with a glance at the Dutch original occasionally so far as braid Scots and German can carry one.

THE TEXT.

“In some general introductory remarks Numan points out the apparent predisposition of the calf to deformities. Thus the sides may be folded back in an inverted way and the whole body turned over so that the vertebral bodies are

* This account is in no sense a translation but a free summary.

placed above and the spines directed downwards, with the abdominal and pleural cavities still unclosed. Deformities of the head are common,* and the same applies to sheep. Polydactyly is also more frequent in pigs than in other species, and the limbs may acquire an apparent resemblance to the hand of man.

"The cow presents, however, a special deformity in regard to the genital organs, with sterility as a result, the animals having the appearance of oxen, and being termed *kween* in Holland and *bouquetin* in Brabant, *i.e.* hermaphrodites. The term *bouquetin* is also applied to hens taking on the characteristics of cocks. The anomalous animals called *kween* are named *free-martins* in England. As Simpson pointed out and Numan emphasises, this condition was known to the Romans under the term *taura*, as well as in modern times in Normandy; in France (known as *taur*), and as already said, in England (free-martin); in Germany as *Zwitter*.†

"The uncertainty attending such genital deformities prompted the Society of Arts and Sciences of Utrecht to propose, in 1833, a competitive research *a propos* of the belief among agriculturists that when a cow has twin calves, one a male, the other a female, the latter, which is termed a hermaphrodite, is incapable of impregnation. The following were the queries laid down :—*Quelle valeur possède cette observation des éleveurs? Est-elle suffisamment fondée, peut on l'admettre comme une loi de Nature? En quoi diffèrent les vaches hermaphrodites de celles qui ne le sont pas, quant à leur conformation extérieure et intérieure? Quelle différence remarque-t-on dans l'habitude extérieure, entre les vaches hermaphrodites et celles que l'on a rendues stériles par la castration? Les vaches*

* See Gurlt's *Atlas*, pt. iii., for agnathous lamb.

† The origin of the term "free-martin" is obscure. The most probable explanation seems to me to be as follows :—*Farrow* = sterile in Scots and north of England dialects. *Mart* was the cow or ox killed and salted at Martinmas for use during winter. For this purpose a cow that had missed calving or a heifer that was sterile and differed from an ordinary heifer, as the free-martin does, would be selected, as a fertile cow would be kept for breeding. The selected apparent heifer might then be termed the "Farrow-mart-one," or in Scots the "Farrow-mart-yin," and this might be corrupted or shortened into "free-martin" (see Wright's *English Dialect Dictionary* and J. W. Ballantyne in the *Brit. Med. Journ.*, 7th May 1910, article, "The History and Etymology of the Free-Martin," p. 1125).

hermaphrodites présentent-elles aussi entre elles quelques différences apercevables; dans l'affirmative, en quoi consistent les différences? Y a-t-il des causes auxquelles on doive attribuer ce singulier phénomène, et le rencontre-t-on encore chez d'autres espèces animales?

"No response was made to this well-stated series of queries, and therefore Numan began his investigation, publishing it in 1843, without, however, for personal and other reasons, sending it in to the Society.

"He discusses the whole subject as follows:—

"(1) Quelle valeur possède cette observation des éleveurs?

"(2) Est-elle suffisamment fondée, peut on l'admettre comme certaine, infaillible, comme un loi de la Nature?

"(1) *What value does this observation of stock-raisers possess?*

"(2) *Is it sufficiently established? Can one admit it as certain, infallible, as a law of Nature?*

"These two questions are one, and can be treated conjointly.

"The agriculturist constantly in touch with cattle is necessarily much struck with cases of twins where one is a male and the other an apparent female, and that the latter is sterile and partakes of male characteristics. The questions arising from this will be discussed by them sooner than by naturalists. Eminent naturalists have doubted the agriculturists' opinions on this subject, and others have rejected it. Camper declared the belief that the co-twin apparent female is sterile, a ridiculous absurdity; Blumenbach also doubted it on insufficient grounds; other authors—Scarpa, Smellie, Hunter, and Meckel—admit the opinion as one based on experience. The last author thinks that if this rule has exceptions his researches tend in the majority of cases to confirm the opinion of Hunter and Scarpa. If a long succession of facts from time immemorial has established that this fault of sterility is attached to the apparent female co-twin one asks, Is the phenomenon constant? Does the female always show anomalies? Are they among the immutable laws of Nature? In countries rich in cattle, for instance in the province of Groningen, the stock-raisers consider the condition as constant, and in a prize memoir '*Sur les qualités du bétail*' G. Reinders, an able scientific agriculturist, says: 'Il paraît étrange, et cependant l'expérience le confirme, lorsqu'une vache porte deux fœtus, dont un mâle et une femelle,

cette dernière par la suite est ordinairement une vache stérile.' Some observers whose testimony is trustworthy have assured me that there is no case to the contrary. Other stock-raisers at Utrecht agree with the above, but state that the rule has numerous exceptions. Thus M. G. Reinders communicated to me that the co-twin apparent female may not be a hermaphrodite, and M. Bouman has seen three cases where conception took place. Observations in Germany, England, and France accord with these remarks. Hunter thinks that the twins of different sexes can have the genital organs well formed. Meckel does not admit that the sterility of the female is universal, and Blumenbach reports a case of conception. Earl Spencer stated that he had frequently heard it said by agriculturists that a heifer born with a bull was capable of procreation, but that he had never seen an example of this. Schaeven, a veterinarian at Erkelenz, announced some facts known to him quite contrary to the view of sterility. Buchan of Killingtringham (*sic*) gave in the farmers' magazine for 1806 an account of a hermaphrodite cow which had a calf. The same proprietor had another which was sterile. An anonymous writer in 1807 gives an account of a cow which in November 1804 had two calves, one a male, the other a female. In the spring of 1807 the latter gave birth to a male calf, and at the same time a neighbouring proprietor had a heifer arising from a twin labour with different sexes, and the heifer in its fourth or fifth year 'n'avait jamais souffert les approches du taureau.*' Youatt, who reports these facts, remarks that it is a rare exception and a deviation in the natural history of bovine animals to see a similar (*semblable*) cow have calves, seeing that one should consider it as a hermaphrodite; it is apt for procreation when the generative organs are not bisexual, or where the female apparatus predominates. For the moment I do not consider this remark, but return to it when discussing hermaphroditism.

"For several years I had made observations on this subject, and these have confirmed me in the opinion of those who admit that the exceptions mentioned are not very common, but nevertheless do exist. I shall give only one example. I received in 1829 at the Veterinary School two

* As we shall see, if a male and female twin calf are fertile they arise from separate fertilised ova, and the female is not a free-martin.

calves of one birth (*d'une même mise-bas*), a male and a female. The latter was reserved for experimental trial. There was no difference between its conformation and that of another animal. In its second year 'l'orgasme vénérien s'éveilla; elle fut accouplée le 31 Janvier 1831 et donna un veau le 29 Octobre suivant.' This cow, being a good milker, was bred from and had several calves. Quite a number of such cases are known, but it would take up too much space to recount them. These examples appeared to me sufficient to demonstrate that sterility is not irrevocably bound up with varying organs in a male and female calf, and that one cannot consider it, under these circumstances, as a general law of Nature.* ('Ces exemples me paraissent suffisants pour démontrer que la stérilité n'est pas irrévocablement liée aux parts doubles d'un veau mâle et d'un veau femelle, et qu'on ne peut la considérer dans cette circonstance, comme une loi générale de la Nature.')

"The preceding observations raise the uncertainties which still exist on this question, but there is a second one at present as follows:—Is sterility in a cow depending on a maldevelopment of the organs only present in twins of different sexes or when the twins are of the same sex? The first is a case of sterility of the cow, but as to the second some German writers speak of hermaphroditism of the cow in twin births without specifying the sex. The want of direct observations hinder me from settling the question, nevertheless the following facts warrant me to suppose that in the double organs of two females there may be a hermaphroditic condition:—

"On the 3rd April 1834 I saw with M. Beukhout, an agriculturist of Maarssen, a female twin. The female co-twin had been sold shortly after birth on account of her small size. This animal was about 2 years old. She resembled the ox in external conformation. The horns were wide apart (*écartées*), and longer and finer than is wont. The head was straight and more elongated than in an ordinary cow. The vulva was narrow, so that it was scarcely possible to introduce a finger; the vulvar labia were small and atrophied. The *bouquet de poils* and the clitoris were not well developed. In the mammary region there were four little teats of the same

* It may be mentioned here in advance that such cases arise from separate fertilised ova. The free-martin and potent twin arise from one.

size as one meets in the bull. There was no trace of an udder, at least what one regards as such, and the skin, usually a little abundant in that region, was lax and pendent like a sac. Not having been able, to my great regret, to examine the internal generative organs after death, I am in uncertainty as to their formation. If it is certain that I was not deceived as to the sex of the sister co-twin, and the owner has given me formal assurance on this point, one can admit that we may have double parts in two female calves in place of the incomplete development which characterises hermaphroditism.

"One still holds that when the twins are males neither is impotent. Experience has shown me that this rule is not without exception.

"In 1832 M. van der Vaart had at Maarssen a cow arrived nearly at term. As she was unable to rise owing to feebleness of the back, it was thought she could not undergo parturition; otherwise she was sound. The owner determined to deliver by abdominal hysterotomy (*par l'hystérotomie abdominale*) and to slaughter her immediately afterwards. Two male calves were obtained. The one was castrated by complete section of the scrotum at the abdomen, the procedure (*que l'on appelle raser*) practised by agriculturists, who state that this operation carried out at the right time and in this way gives to the ox a more delicate flesh and fine and long horns. The second calf was considered impotent, and was bought by me in March of the following year. It was in a miserable condition and had the following characteristics:—It was piebald (*pie baie*). A little below the anus in the perineum one could see a small opening for the escape of urine. There was hypospadias, and the urethra was easily felt at the edge of the ischial arch. It opened externally about two handsbreadth below the anus in a fissure of the skin, the glans being imperforate; this cleft presented in some sort the aspect of a vulva bounded by its two labia; it was provided inferiorly with a voluminous tuft of hair (*haarlok* in Dutch). On 10th June the animal was again examined, and the testicles were felt very distinctly in the groins, and where one should have the scrotum, which did not exist, there were four little nipples. Instead of the phallus there was an imperforate dilatation of skin without

the hairtuft which surmounts the prepuce in the bovine species. Both animals ultimately grew well.

"On post mortem of this supposed hermaphrodite female the organs were found as in Plate XI.* This animal appears, therefore, to be a hermaphrodite, to which the term 'taure' is given. According to my results such animals should be looked on (*envisagées*) as veritable bulls whose generative apparatus, internal and external, is more or less incompletely developed; this gives an appearance of deformity and a certain resemblance to hermaphroditism.

"Numan gives other cases, but as he did not recognise that those of his cases that were similar to John Hunter's were defective males, and also imported into the question the idea of hermaphroditism, it would only introduce confusion to give them, and I therefore pass them over."

I now give Numan's conclusions on this point, with explanatory remarks:—

"1. Lorsque une vache met bas deux veaux, l'un mâle, l'autre femelle, cette dernière a presque toujours les organes de génération mal conformés ou incomplets et elle est frappée de stérilité.

"The real statement should be that both are males, the one normal, the other with a small undescended testis, and the epoophoron of its normal co-twin given to it (see paper † on 'Free-Martin' by the author). This is the ordinary free-martin, and has no rudimentary prepuce.

"2. Ce fait fondé sur l'expérience des cultivateurs, confirmé par des observations anciennes et modernes, comporte pourtant des exceptions qui ne permettent pas de le considérer comme une loi fixe de la Nature.

"These exceptions are where the twins, male and female, arise from separate zygotes. As we shall see, the potent twin (male) and free-martin are from one zygote.

"3. L'anomalie ne se borne pas exclusivement aux gestations doubles de fœtus à sexes différents; elle peut aussi se présenter, quoique plus rarement chez les jumeaux de même sexe.

* In Numan's *Atlas*. It is a case of undescended testes. The external genitals are feminine, but might be considered hypospadiac. It is not a stierkween as Numan figures it.

† *Proceedings of the Royal Society of Edinburgh*, 1910-11.

"This is in the case of Numan's *Stiermartin*, also a free-martin, where he recognised the sexual glands as testes.

"4. Le vice de conformation dans les parts doubles à sexes dissemblables, n'est pas exclusif à la femelle; le mâle en présente aussi des exemples et alors la femelle est régulièrement conformée: seulement les faits de ce genre sont rares."

By this he means that Hunter's free-martin is a female and the *Stiermartin* a male. The former is wrong, the latter right. Another most interesting question is as follows:—Can we have a normal female and a female deformed in its genitals in twins of one zygote? I certainly hold theoretically that we may have a normal female and a deformed female with part of the vagina (lowest $\frac{1}{3}$) and the epoophoron, the non-potent male element of the female, segregated into it. One such case is quoted by Numan, but the record is imperfect.

"5. Les gestations doubles ou multiples peuvent être considérées dans l'espèce bovine comme la principale, et quant au veau femelle, comme la condition la plus certain et la plus constante d'hermaphrodisme; d'autant plus que l'anomalie des organes génitaux, cause de la stérilité, n'a pas encore, à ma connaissance, été observée parmi les veaux femelles, provenant d'une gestation simple. On rencontre plus souvent l'appareil sexuel incomplet chez l'individu mâle, qui se trouve dans le même cas, raison pour laquelle il mérite, d'être placé au nombre des hermaphrodites."

The first part of this conclusion is right as to the frequency of twins in cattle, but wrong in considering the free-martin as a hermaphrodite, which it is not. The second part of the conclusion as to the frequency of the male single at a birth having apparent hermaphroditism as compared with the single females is striking, and indeed I consider a so-called pseudo-hermaphrodite as usually a maldeveloped male. This is to be judged by the sexual gland, of course, and not by the apparent female portion of the lower tract, which is really the hydatid testis and prostatic utricle.

We now pass on to another head.

"3°. En quoi différent les vaches hermaphrodites de celles qui ne le sont pas, quant à leur conformation extérieure et intérieure.

"Numan gives an excellent description of the free-

martin, or, as he terms it, hermaphrodite (Plate I., 1 and 2). There is greater growth of the horns, greater length, but they are proportionally thinner, straighter, pass up and back, and are like those of the ox. As in the ox, the circular ridges showing the age of the animal are less distinct. They have the head gaunter, slightly elongated, etc. The body may be large, both broader and higher. The bones are smaller, and the animals stand higher on their limbs.

"The vulva is narrow and the labia finer and shorter; the vagina appears contracted, the clitoris usually more voluminous. The udder is little developed, and often merely a wrinkled and folded dilatation of the skin. In some the skin there hangs as a voluminous pouch, like a real mamma, or may be so little marked that no mammae appear to be present. One finds, nevertheless, the number of teats proper to the cow—four to six.

"The consideration of the internal organs is postponed until the organic causes determining hermaphroditism are taken up.

"Numan gives some interesting facts as to the results of spaying in cows, and compares the results with the conditions in Hunter's free-martins on the supposition that these are females. Such spayed cows attain enormous weight, and the operation in vogue, chiefly in the province of Groningen, gives, it is said, an animal fat and with tender flesh.

"4°. Quelle différence remarque-t-on dans l'habitude extérieure, entre les vaches hermaphrodites et celles que l'on a rendues stériles par la castration ?

"5°. Les vaches hermaphrodites présentent-elles aussi quelques différences apercevables : dans l'affirmative, en quoi consistent ces différences ?"

Numan discusses in the first place the differences between what he terms the male hermaphrodites and the female ones. These are, however, both male, as testicular tissue has been found in John Hunter's free-martin specimens still preserved at the London Royal College of Surgeons. The forms Numan describes, in addition to those like Hunter's, have a slightly different genital external development, the prepuce being present in a rudimentary condition and the testes more evident, although in an undescended condition either in the abdomen or in the groin. He thus discusses a non-existent sexual difference, but his description of

PLATE I.

FIG 1



FIG 2

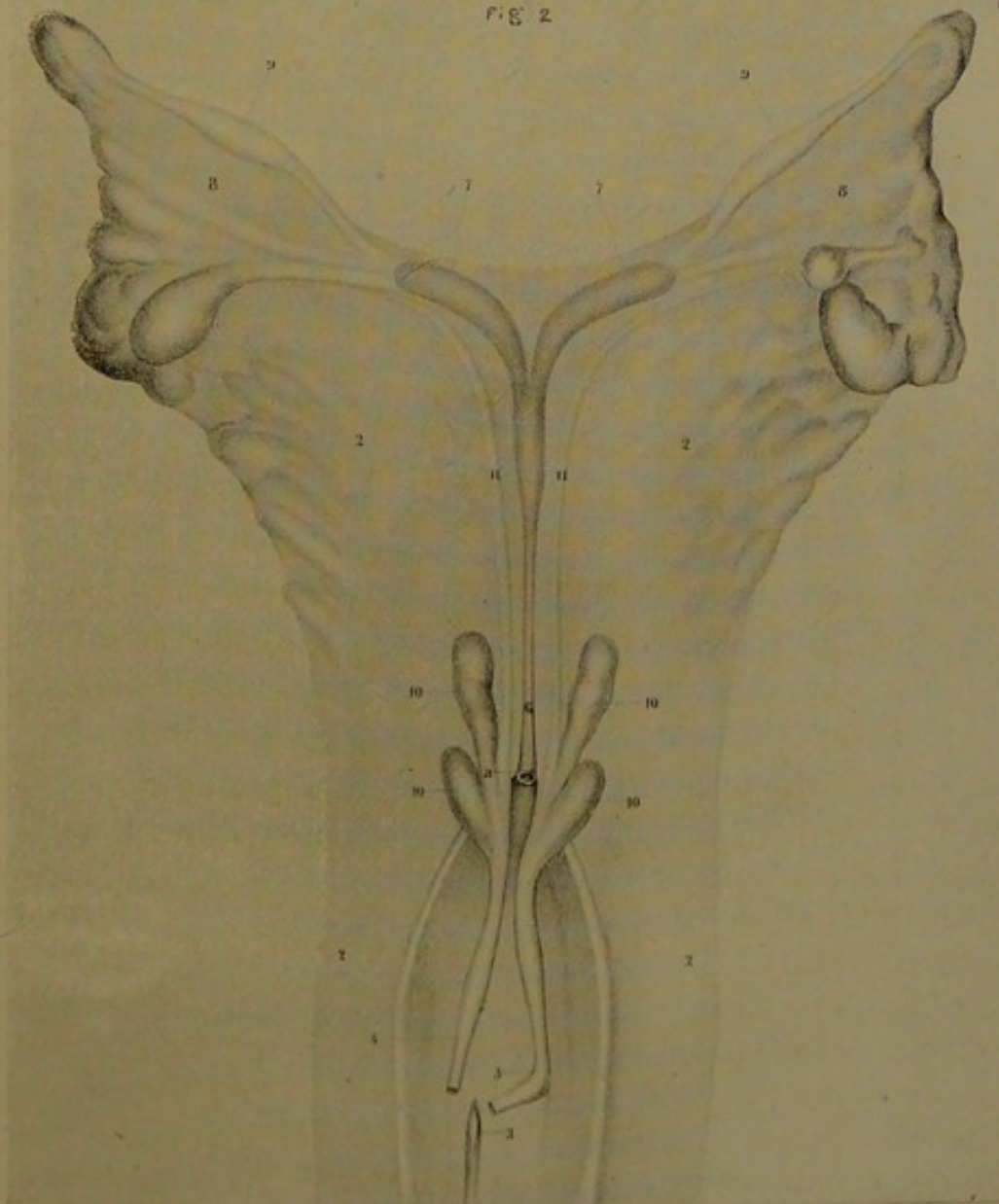




PLATE II.

Fig 1



Fig 2



Fig 3

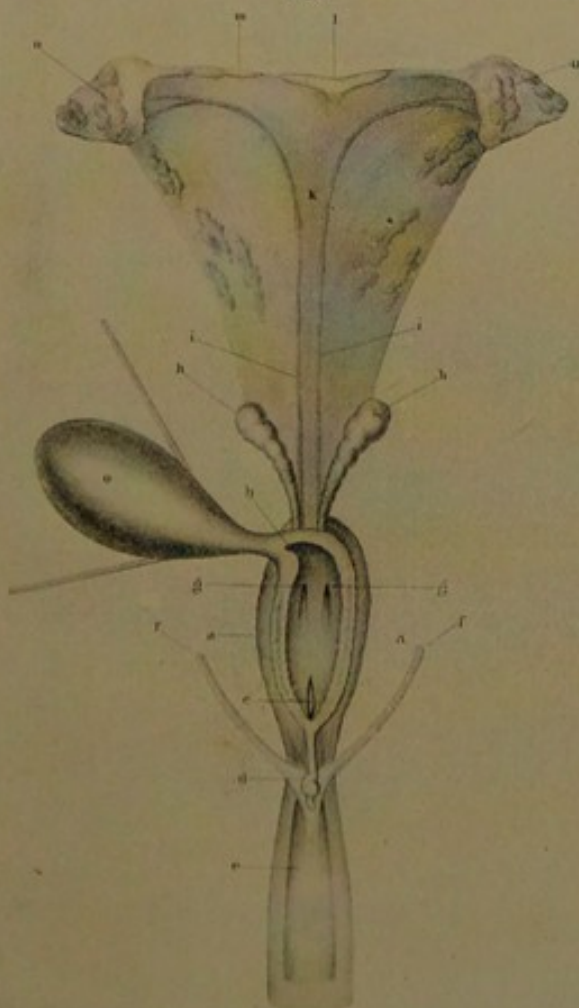
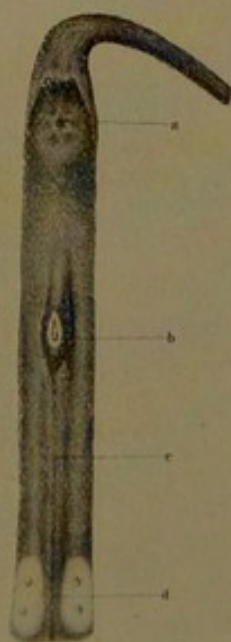


Fig 4



II PART



his own form of free-martin (*Stiermartin*) is valuable. In Hunter's and analogous specimens the testes are higher up in the peritoneal folds, and look like small ovaries as to position (Plate I., Figs. 1 and 2).

"The *Stiermartins* (*hermaphrodites mâles*), although resembling the female (*hermaphrodites*) as to the port of the horns, preserve more the natural conformation of the bull (Plate II., 1, 2). The body does not, as a rule, have a considerable development. It has more analogy to the ox than to the female hermaphrodite. It is similar in the separation, sweep, and length of the horns. The head possesses more the form of the bull. They thus approach to the bull when the testes are more completely developed, and to the female form if these are less so. Further distinctions between the *Stier*- and Hunter's free-martin are given, but as the sex is the same—male—it is unnecessary to give all the details.

"The testes are not in the scrotum. There is a fissure in the perineum with a very short phallus, testes more or less descended. The testes may be wanting or represented by amorphous fat with no proper testicular tissue. Sometimes the scrotum is open and bilobed. In one case with defective external genitals, no vulva and no vagina, there were also no testicles, matrix, nor ovaries. This case is given in great detail. Numan also mentions lunar hermaphrodites where a lunar and exciting influence seemed to be exerted on the mammæ of certain animals, but states he could find no convincing argument for such.

"Numan sums up this section as follows:—'Il conste de ce qui précède, qu'il existe dans les bêtes bovines, une différence marquée entre l'hermaphroditisme masculin et féminin, ainsi qu'entre les vaches hermaphrodites et celles que l'on a châtrées: tandis que dans les hermaphrodites mâles et femelles, on rencontre encore des variétés individuelles; mais il serait difficile d'en donner une description détaillée sans entrer dans des développements trop étendus.' This must be read in connection with what has been already said.

"6° Observe-t-on encore l'hermaphroditisme chez d'autres animaux?"

In this section Numan discusses hermaphroditism in other animals, especially in the horse, and also in the sheep and goat. In the horse it is very remarkable, and, so far as I know, only

described by John Hunter. In all the literature Numan gives on this subject there is only one English reference to a paper by Wotton in the *Veterinarian* for February 1841. Gurlt figures cases in the goat and sheep analogous to the free-martin—

“An important point to settle in such is whether there was a twin birth. Sebald, von Jennecker, Gohier, and others give no information on the nature of the birth. If the horse is advanced in age information cannot be obtained.*

“7° En quoi consiste le véritable caractère de ce vice de conformation, tant dans la bête bovine mâle que femelle ?

“In speaking of the hermaphrodites Numan singles out what he has described as female hermaphrodites for special consideration, the female hermaphrodite being Hunter's free-martin. In these the horns are distinguished by being wide apart, very fine like those of the ox, by a narrow long head and a condition of the bones (ossature) less strong proportionately to their size. They are extraordinarily liable to be fat, and have the flesh delicate and very tender.† The vulvar labia are more or less imperfect, the labia minora small and atrophied, clitoris often voluminous, and longer than in the normal cow. It is not rare for it to go beyond the labia and be then somewhat like a small gland. The vagina is absent or less deep, narrow or terminating soon in a cul-de-sac. The uterus is at the same time very incomplete, and the body is often hardly recognisable and obliterated. In certain cases it only presents a rudiment of a membranous expansion with cords and knots here and there,‡ and sometimes a thin broad outline of the cornua. The cornua are always defective, but the tubes and ovaries § are present in a very imperfect condition, and in place of ovaries § one finds balls of fat (*des pelotes graisseuses*), studding the borders and surfaces of the broad ligaments.|| Two such were discovered during the siege of Maestricht (1838-39).”

* This is a difficulty in sale cattle, as usually no history can be given as to whether the animal was one of twins or single. In one free-martin I learned from the owner that the animal was from a single birth.

† John Hunter mentions this as a belief in England. Sometimes they are not, and perhaps there is then more testicular tissue than usual.

‡ I have seen this twice or thrice.

§ Really testes.

|| This is well shown in the plates.

Here Numan makes an important statement which I quote:—

“ Dans les hermaphrodites femelles, il n’y a jamais, autant que mes recherches me permettent de l’affirmer, mélange d’organes genitaux mâles et femelles et le nom *d’animaux à double sexe d’hermaphrodites* ou *Zwitter*s, que leur donnent les auteurs français, anglais et allemands, est, par conséquent, inexact. La nature de l’imperfection dépend plutôt d’un développement incomplet de l’appareil sexuel, dont la cause première réside dans une perturbation de la force de formation à une époque peu avancée de la vie fœtale. Elle doit donc être attribuée tout simplement à un arrêt dans l’évolution” (*Hemmungsbildung*).

This is an excellent statement, and places Numan’s work on a high plane. Had he interpreted the supposed canals of Gartner and the projections from them as the vasa deferentia and vesiculæ seminales and not as the analogous Gartner’s canals he would at once have seen that what he described as ovaries must be testes. There was unfortunately no microscopic examination in his time.*

He now goes on to describe what he believed to be Gartner’s canals.

“ Plate II., Fig. 3 represents these glandulo-tubular organs such as are seen in one of the hermaphrodites I have dissected after having injected them with mercury. They are displayed completely and in a developed condition. I have neglected their existence, my attention not being fixed on this organic system; but one can see the exact drawings of these in the subjects I examined. In Plate IV.† these glandulo-tubular organs” (really vasa deferentia and vesiculæ seminales) “are entirely broken up (*brisés*), the uterine neck being entirely formed by their scattered elements or been mingled with them. In my remarks on hermaphroditism of the bull I shall again have occasion to return to Gartner’s body”‡ (or canal).

* He recounts a case, however, by Gurlt where the microscope was used.

† In Numan’s *Atlas*.

‡ What Numan means is this. In what he termed female hermaphrodites vasa deferentia and vesiculæ seminales are present, as figured by Hunter. Numan thought they were Gartner’s canals, and figured the sexual glands as ovaries. In the *Stiermartin* the testes are more evident, and he saw they were bulls, and therefore this explanation.

Numan then goes on in an important note to abstract and add to the original paper by Gartner, and I therefore transcribe it as a whole.

Numan's Note on Gartner's Canals.—The observations of Gartner, a Dane, on the persistent Wolffian ducts in the cow and sow are often quoted, but no statement as complete as Numan gives in this note in his monograph is known to me in English, and I therefore quote him in full on this point:—

“Quoique Galien (libr. ix. *De dissectione vulvæ*) paraisse déjà avoir connu ces organes et qu'ils aient été décrits par Malpighi (*Epistola ad Sponium*, pag. 26) et par Haller (*Elementa Phys.*, libr. xxvii. au mot *Muliebria*) ils semblent, depuis ces anatomistes avoir été perdus de vue, et leur histoire est tombée dans l'oubli, au point que, dans les ouvrages modernes de médecine vétérinaire, de physiologie et d'accouchements, on les passe sous silence, ou on ne les indique que superficiellement. Le médecin danois H. Gartner,* fut, par hasard, remis sur leur trace; il en fit l'objet d'un examen spécial, et on leur donna son nom. On en trouve une description, avec figures, dans *Kongelige Danske Videnskabernes selskabs Naturvidenskabelige og Mathematiske Afhandlinger*; Kiöbenhavn, 1824, Förste Deel, page 279, sous le titre: *Anatomisk beskrivelse over et ved nogle dyr—arters uterus undersøgt glandulöst organ*. Ce travail est analysé dans *Medicinische Zeitung*, 1824, S. 104. L'attention des principaux physiologistes est encore une fois fixée sur ce système d'organes. Ce sont des corps, partie glanduleux, parti tubiformes, situés à l'orifice et au col de la matrice; ils s'étendent le long du corps et des cornes de cet organe, vers les ovaires où, sans les atteindre, ils se perdent dans les ligaments larges. En bas et en arrière ils se terminent de chaque côté, à la hauteur du canal de l'urètre par une ouverture dans le vagin. Ces organes existent chez le cochon, la vache et aussi, suivant quelques-unes, chez la jument. Leur composition et leur direction ne sont pas les mêmes chez ces divers animaux; ils n'ont pas le même développement à toutes les périodes de la vie, et dans tous les cas, on ne les voit pas aussi distinctement; cela dépend du rut, de la gestation et d'autres circonstances. Plusieurs, entre autres, Hildebrandt (*Handbuch der Anatomie des Menschen*, Braunschweig, 1832, Th. iv. S. 445, 447), Jacobson,

* Usually written Gärtner in English as if he were a German.

Baer, Rathke (*Ueber die Bildung der Samenleiter, der Fallopische Trompete und der Gartnersche Kanäle in der Gebärmutter der Wiederkäuer*, dans Meckel's *Archiv für Anat. und Phys.*, Bd. vi. S. 379). Müller (*Bildungsgeschichte der Genitalien*, Dusseldorf, 1830, S. 127), Gurlt (*Lehrbuch der vergleichende Physiologie der Haussäugethiere*, Berlin, 1837, S. 239) regardent les canaux de Gartner comme les débris des canaux excréteurs des corps de Wolff, ou du moins comme étant en rapport avec ces derniers. Gurlt suppose que les organes ou canaux de Gartner se retrouvent chez tous les animaux, quoiqu' on ne les observe distinctement que dans les ruminants et les solipèdes.

" Dans les *Anatomische Abbildungen der Haussäugethiere*, pl. 74, figures 2, 8, 8, de Gurlt, deux ouvertures sont indiquées sous la dénomination d'orifices des conduits vaginaux; on veut, sans doute, désigner les ouvertures des canaux de Gartner.

" Après un grand nombre de tentatives réitérées et vaines, j'ai enfin acquis la conviction que dans le mouton, on rencontre des rudiments de ces organes; ils s'abouchent par deux orifices dans le vagin, près du canal de l'urètre: je n'ai pas réussi, jusqu' à présent, à y faire pénétrer une injection mercurielle.

" Gartner remarque que leur ouvertures, dans le vagin de la vache, sont plus grandes que chez le cochon, et qu'elles sont situées plutôt en avant que sur le côté de l'orifice de l'urètre. Ces corps commencent par deux dilatations, sous forme de poches, appelées petites têtes (*capitula*); celles-ci se transforment en deux canaux qui se dirigent en haut, le long de la face interne du vagin, et arrivent jusque près de l'orifice de la matrice. Ici ils s'arrêtent et paraissent se terminer; mais ils plongent dans le tissu du col de l'utérus, et se représentent là où le col se confond avec le corps du viscère. Ils reparaissent encore à la face inférieure de la matrice, remontent le long du corps, se dirigent concentriquement avec les cornes, et disparaissent à quelques pouces de distance des ovaires.

" La partie du canal qui appartaient au col de la matrice, est sujette chez la vache, à des changements déterminés par l'âge et la fécondation de la bête. La continuité de la portion vaginale et de la portion utérine est ordinairement rompue, en apparence. Dans la région où

les canaux rampent sur le col utérin, on trouve une rangée de petits élevures ou tubercules, qui ont un aspect glanduleux, et qui doivent être considérés comme un lien entre les deux parties principales de ces tuyaux. Parfois, il existe, au lieu de ces tubercules, un véritable canal. Celui-ci présente alors des dilatations sur les parties latérales; des vaisseaux sanguins les tapissent; il semble être un conduit excréteur commun. Ces dilatations donnent parfois au canal la forme d'une spirale. Dans un cas où le canal était ainsi contourné d'un côté, il se présentait, de l'autre côté, une quantité de cellules dilatées, dont quelques-unes avaient une dureté presque cartilagineuse, et une ouverture assez grande, pour y introduire le bout du doigt. C'est chez la vache adult que cette forme est la plus prononcée. Les tubercules sont parfois remplis d'une matière muqueuse. Il est rare que les canaux des deux côtés du col utérin, aient le même développement; car, quand on trouve d'un côté un canal, il y a de l'autre, des élevures glandulaires. Dans le veau le canal est moins interrompu, et non tout à fait spiral. Les cellules ressemblant à des tumeurs cystique, sont en plus grand nombre chez la vache, en automne, que pendant les mois de janvier et de février. De très-jeunes veaux présentent le canal, mais il n'a pas acquis son entier développement, le mercure ne pénètre pas au delà de la partie inférieure de l'ouverture, près de l'orifice de la matrice. Dans quelques cas, on réussit à le pousser jusque sur le col utérin.

“On voit par cette brève description que je n'ai donnée que sous forme d'extrait, d'après une traduction du *Mémoire sur les corps de Gartner*, écrit en Danois, qu'il existe beaucoup d'anomalies dans leur composition; j'en ai eu la preuve dans mes recherches, en les injectant chez les vaches pleines et non fécondées, ainsi que chez celles qui avaient vélé depuis peu. Je ne pourrais dire positivement, avec lequel de ces divers états, leur plus ou moins de développement est généralement lié: de nouveaux travaux sont nécessaires.

“Les véritables fonctions de ces organes ne sont pas encore démontrées. On a prétendu qu'ils servaient de conduits pour amener le fluide séminal jusqu'aux ovaires, et que la fécondation aurait lieu par cette voie. Ces canaux, quoique s'approchant les ovaires, n'ont cependant aucune communication directe avec eux: cette hypothèse est donc peu probable. La structure glandulaire des corps tuberculeux,

la direction tortueuse des tuyaux, semblent faire naître l'idée qu'ils sont plutôt destinés à une sécrétion et à une excrétion qu'à absorber. Servent-ils peut-être à sécréter un liquide qui est répandu chez les femelles, pendant la copulation, *in summa coitus extasi*.

"Les anciens croyaient que la fécondation avait lieu par le mélange des fluides spermatiques du mâle et de la femelle (*Semper enim partus duplici de semine constat*, Lucrèce). Je ne me hasarderai pas à décider la question, mais je pense qu'un système d'organes aussi étendu et aussi compliqué que les corps de Gartner, n'est ni sans but, ni sans signification; ils sont dans un rapport direct avec les fonctions génitales quelle que soit l'influence qu'ils exercent. Ce sujet mérite d'être soumis à de nouvelles explorations."

This is a valuable account of Gartner's original paper on what are now termed Gartner's canals, especially as it draws attention to the parts analogous to the vesiculæ seminales. It is remarkable that although Numan mentions the opinions of Müller and others (*vide antea*), viz. that they represent the Wolffian ducts, he does not dwell on this happy and accurate comparison, but gives as his conclusion the opinion stated in the last two paragraphs of the quotation.

"I may remark that all those hermaphrodites * are really bulls (*véritables taureaux*) whose sexual apparatus is malformed. There is shortening of the phallus and convolutions and curvatures are present. The phallus does not therefore project much under the abdomen, arises a little distance from and below the anus, and shows externally *au travers du périnée* where it is covered with hair. It will not be difficult to distinguish male and female hermaphrodites by the characteristics I have given.† The former, among other things, have throughout‡ male sexual feeling and desire

* This may mean the *Stiermartin* or all the specimens of free-martin figured, probably the former.

† This clearly shows what is not quite evident at some parts of the monograph, namely, that Numan considered the ordinary free-martin as a female hermaphrodite. The *Stiermartin*, which he first described, he considers as a male hermaphrodite, basing his idea of hermaphroditism on the lower tract condition and not on the sexual glands.

‡ John Hunter says the opposite as to the ordinary free-martin. The *Stiermartin* may, however, have such desire, as it has more of the external male tract and better developed testes.

to approach the female. Not having found any mixture of sex in them they should not, it appears to me, any more than the females of this category, be placed among bisexual or hermaphrodite animals. It would be better to look on them as a perturbation or irregularity of the force of formation, the chief cause being the incomplete development of the sexual apparatus, and as a consequence the absence of certain parts, such as the scrotum and testicles. The division of the urethra and scrotum which the hermaphrodite males often show can be referred to a similar cause. I shall endeavour subsequently to demonstrate this.

"Male animals with defective conformation, such as the horse, the ram, the buck, goat, and dog, described as bisexual or as true hermaphrodites, do not differ from the bull as to genital anomalies. It has seemed necessary to me to add to this memoir—as subjects of comparison, and to clear up some of the facts—descriptions and illustrations of certain instances, but not having had any opportunity of seeing such anatomically in the horse and ass I refer the reader to the following authors.*

"In a horse examined by Gohier one found small testes between the aponeurotic expansion of the great oblique abdominal muscles, the defective (*prétendus*) mammillæ and the skin; the vessels were small and their lumen imperceptible. The vesiculæ seminales were small and the prostate and the phallus showed nothing remarkable. The horse had perfect tushes and male sexual habits.†

"In another case by the same author, scrotum and testes were absent; two mammillæ were very evident, and strong tushes were present. No internal sexual organs were found. An analogous case by Tennecker is quoted.

"If one admits that *the presence of the chief genital organs of the two sexes is necessary to constitute veritable hermaphroditism*—that the existence of an ovary or of one or two testes with their epididymis is *de rigueur*—one concludes that these were not true hermaphrodites. The absence of certain parts and of the scrotum does not suffice to establish hermaphroditism, as the absence of a sexual organ does not differ

* Numan gives in pp. 125 and 126 many authorities inaccessible to me. Home is the only English author quoted (*Phil. Trans.*, 1799, p. 158).

† This looks like a case of undescended testes. No mention is made of the condition of the external genitals as having any female characteristics.

from other anomalies *par defect*. It is still necessary, if I am not deceived, to distinguish imperfection of sex and neutrality, from hermaphroditism.*

"Certain anatomists—Hunter, Mascagni, Scarpa, Borkhausen, and several others—have described and figured these individuals as true hermaphrodites in which they assert (*on prétend avoir*) they have found the generative organs proper to both sexes in one and the same animal. It would be perhaps rash to deny boldly the value of the observations of these celebrated men and to assert in fact that they had erred in their investigations. I recognise equally the importance of the considerations stated by other physiologists not less renowned touching the non-existence of hermaphroditism in the true sense of the word, and founded on their anatomical data. J. Müller thinks that those who have believed that they saw a mixture (*mélange*) of the sexes in one and the same individual are in error. He maintains that he has never met at the same time testes and ovaries, and then goes on to detail the possible errors in observation. Who, he asks, guarantees us the conscientious examination of the organs in the anomalies described up to this time? Who has seen the vasa deferentia of the testes? Who has examined the epididymis? Numan emphasises the above by his own observations and goes on to criticise Hunter's cases.† This is of interest, and I therefore give it fully.

"Hunter describes a hermaphrodite animal which resembled an ox more than a bull or cow. The vagina was blind, and terminated a little above the urethral orifice, and at this point it was closed as well as the uterus. The latter viscus was divided into two horns, at the extremities of which were testes in place of ovaries. They were more than twenty times the size of a cow's ovary and also as big as a bull's testes. The vesiculæ seminales or pouches (*beutel*, bags) were placed between the bladder and uterus; their ducts opened in the vagina a little above the urethral orifice, but one cannot discover anything which had any relation to the vasa deferentia. The external genitals were more those of a

* Nothing could be put more admirably, especially the underlined portions. It is the neglect of these principles that has made the present-day confusion in regard to hermaphroditism.

† Numan quotes Hunter's well-known *Observations on Different Parts of the Animal Economy*, Scheller's translation.

cow than a bull, the clitoris feminine, and not in size between the clitoris and phallus, as one notes in the hermaphrodite horse Hunter describes.* There were four mammillæ, and the glandular substance was small.

"Numan next describes Mr. Arbuthnot's free-martin (Pl. I. of Hunter's monograph), where Hunter stated there were ovaries and testes. This, however, is a mistake, as Spiegelberg showed in his case that the two bodies were testes and Wolffian body remains. Finally, he gives Hunter's third case, Well's free-martin, and criticises Hunter for describing certain parts of the narrow tubes as vasa deferentia, and states: 'Il me semble qu'on trouve dans ces descriptions des indications non équivoques que les canaux et les corps de Gartner ont été confondus avec les conduits déferents et les vésicules séminales.' Hunter, however, was right, and Numan made a cardinal mistake in describing the vasa deferentia and vesiculæ seminales in certain of his cases as Gartner's canal and body. Had he not, he would have had the honour of showing that the ordinary free-martin is a defective bull like the *Stiermartin*, i.e. all free-martins are male in sex.

"8° A quelles causes les plus probables doit-on attribuer cette anomalie ?

"This is the last question Numan considers, and does so at considerable length. I must take it up, however, briefly, for reasons of space. Numan passes from his abundant facts to speculation. *J'arrive sur la terrain de la spéculation* is his statement. He points out that animals destined to produce one foetus at a birth are apt, in producing twins, to have one of them deformed. Meckel and Vrolik, whom he quotes on this, point out that apparently the force to produce one subject is not sufficient for two, and one naturally recalls allantoïdo-angiopagous twins in this idea.

"In animals giving rise to several young, as in ewes, sows, etc., when the number is above the average foetuses, less developed or defective are found to occur. The apportionment of the force of formation among several individuals at one time and the insufficiency of nourishment may check certain elements that are proper to development. The same will hold in the cow if we regard twinning in man and in

* This is Hunter's Mr. Wright's case. I have compared Hunter's text and plate and find Numan accurate in his summary.

cattle in the same light. Gurlt gives a statistical table of 740 monstrosities in domestic mammals, the proportions being as follows:—

“ The ass . . . 3	The dog . . . 78
The mule . . . 3	The pig . . . 87
The goat . . . 24	The sheep . . . 179
The horse . . . 56	The cow . . . 239”
The cat . . . 71	

One sees from this how bovine animals greatly outnumber those of other species in the number of deformities. He draws a graphic picture of the artificial life of the cow, and thinks that this, especially the persistence of lactation during gestation, disturbs nutrition and affects the offspring in the direction of deformity. The persistent confinement of the animal to a constrained position he also thinks a factor.

He discusses Earl Spencer's valuable researches* as to the duration of gestation in the cow, but I postpone the consideration of these to another occasion.

Numan thinks that double and monstrous births are influenced by local and temporary causes—atmosphere, vegetation, force of rut, and so on—but this need not be detailed, and some of his results are based on error—for instance, that of the ordinary free-martin being a female hermaphrodite instead of a sexually imperfect male. He notes that the potent twin is usually larger and first born. According to him the peasants say: “*Le mâle s'est rendu maître de la femelle, en lui ravissant une partie de la nourriture qui revenait à cette dernière.*” In conclusion Numan discusses the effects of castration in the male, and compares such with the free-martin. He also applies skilfully the physiology of his time to elucidating the nature of the rudimentary mamma, but as this summary has already run to some length I omit all reference to this part. He finally and rightly finishes by asserting that such monstrosities are not hermaphrodites, in spite of the general opinion of his time to the contrary.

* Earl Spencer's statistics are valuable. In 764 cows the interval between insemination and the birth of the calf lay between 220 and 313 days. The statistics as to the births are 340 cow-calves, 395 bull-calves, 7 twin cow-calves, 5 twin bull-calves, and 11 free-martins, the last all sterile and described as 11 twin cow- and bull-calves—an average of 1 in 69.

THE ATLAS.

The atlas itself is a handsome large quarto, text and plates separately bound in green paper. The titles are—

VERHANDELING
OVER DE
ONVRUCHTBARE RUNDERN

BEKEND ONDER DEN
NAAM VAN

KWEENEN,

in verband tot sommige andere
dieren met misvormde
geslachtsdeelen
Met 23 groot-kwarto platen

DOOR

DR. A. NUMAN, ETC.

UTRECHT

N. VAN DER MONDE

1843

For the plates the title is—

PLATEN

BEHOORENDE BIJ DE
VERHANDELING

OVER DE

ONVRUCHTBARE RUNDERN

BEKEND ONDER DEN NAAM VAN

KWEENEN,

in verband tot sommige andere
dieren met misvormde
geslachtsdeelen

DOOR

DR. A. NUMAN

23 Platen

UTRECHT

N. VAN DER MONDE

1843

A fairly long list of subscribers to the monograph is given, but they are all Dutch. W. Vrolik of Amsterdam, the author of

the well-known atlas, *Tabulæ ad illustrandam embryogenesin hominis et mammalium tam naturalem quam abnormem* (1849), is a subscriber. The plates themselves are large and very artistically executed. They are briefly as follows:—

Pl. I.—Vaarskween or free-martin. Pl. II.—Internal organs of I. with small separate portions of testes described as ovaries (eijernesten); vasa deferentia and vesiculæ seminales described as Gartner's canals (onvolkommene Gartnersche buizen); the external genitals are figured. Pl. III.—Internal organs (Fig. 1) and external genitals of a vaarskween; ovaries and Gartner's duct described instead of testes, vasa and vesiculæ seminales. Pl. IV.—As in III.; much as in II. and III., but a great many clumps of fat. Pl. V.—As in Pl. IV.; internal organs as in others. Pl. VI.—Another vaarskween or free-martin. Pl. VII.—Internal organs of animal in VI.; well marked. Pl. VIII.—Organs in Pl. VII., but vasa deferentia and vesiculæ seminales injected with mercury and well displayed. Pl. X. is what Numan calls a stierkween; is like the free-martin, but has a rudimentary prepuce (see text). Pl. XI.—Internal organs of X., and shows condition differing from previous ones; testes, vasa deferentia, epididymes, etc., present; Numan describes this correctly as a male. Pl. XII.—Another stierkween. Pl. XIII.—Internal organs of XII.; these resemble the vaarskween (Hunter's free-martin), and not the stierkween of Pl. X. Pl. XIV.—Internal organs of another stierkween with long prepuce; testes rightly described. Pl. XV.—Calf with double scrotum (balzaak). Pl. XVI.—The same as in XV., with rump held up to show parts on lower surface of abdomen. Pl. XVIII.—Eight-year-old hengstkween or stallion with external parts of mare; testes undescended. Pl. XIX.—Another hengstkween; phallus pendent vertically. Pl. XX.—Hengstkween with phallus pendent (Figs. 1 and 2); directed backwards in Figs. 3 and 4; rudimentary mammæ. Pl. XXI.—As in XX.; phallus directed backwards. Pls. XXII. and XXIII. give figures of goats, a ram, and a sheep whose external organs simulate or are equivalent to the free-martin condition, but the internal organs were not obtained, and therefore it is needless to describe them.

The question still remains unsolved why cattle should have in their offspring such a preponderating number of twins derived from one zygote, and with unequal segregation of the doubled determinants in the zygote. One can only note that the cow has more of the non-potent elements in the shape of Gartner's canal and

glandular structures than other higher mammals. It has thus a less complete phylogenetic elimination of the Wolffian ducts concerned in the establishment of sex, but the exact significance of this, so far as it may permit a more primitive form of twinning in animals usually having uniparous birth, is as yet in the dark. The human species, sheep and goats, etc., have a less representation of Gartner's canal, and in them free-martins are very rare.

HISTORICAL RESUME OF THE NATURE OF THE FREE-MARTIN.

Past Observers.—The chief names associated with the subject of the free-martin are John Hunter, Numan, Simpson, and Spiegelberg.

The popular opinion tenaciously held for many years by agriculturists that an apparent cow calf born co-twin with a potent is almost if not invariably sterile, and presents in many respects the appearance and capabilities of an ox or castrated bull, has been amply justified, and supports strongly a plea much needed for respect to the opinions of practical lay observers.

John Hunter began the inquiry in a most brilliant manner. Of the three specimens examined by him he stated that one had ovaries, vasa deferentia, and vesiculæ seminales, with the external parts and urinogenital sinus of a female; one had both ovaries* and testes; and one testes, the other parts of the genital tract being much as in the first two specimens. Hunter did not recognise that in the case where he thought there were ovary and testis the real organs were testes and Wolffian relics. This has been found to be the case in his specimens still preserved in the Hunterian Museum. The recent examination of these by Dr. Arthur Keith has demonstrated this. This specimen was therefore not a hermaphrodite, as Hunter supposed.

Numan's monograph is the most outstanding of all, and the only recognition it received till lately was in 1861 in Spiegelberg's article, and so far as I am aware, and apart from Holland, it became completely lost. He had, however, examined more specimens than any other observers, figured their external appearance in a most artistic manner, and also given drawings of the internal organs in a most thorough fashion. He recognised that in certain cases—the *Stiermartin*—the animal was a sterile male,

* Hunter drew attention to the fact of the supposed ovary having a capsule with an aperture. Thus the testis is surrounded by a peritoneal capsule, a fact of great significance in its bearing on the normal descent of the testis.

and also combated successfully the view that the free-martin was hermaphrodite. In this he was most advanced, and far beyond the current opinion in many modern circles.

Numan did not, however, see that the free-martin described by Hunter was an imperfect male. He mistook the vasa deferentia and vesiculæ seminales for Gartner's canal of the cow (the rudimentary Wolffian duct), and the testes for the ovary. There was little or no microscopic examination in his or Hunter's day, and thus the error was easily made. He also speaks of the ordinary free-martin—Hunter's free-martin*—as a female hermaphrodite, and the *Stiermartin*—Numan's free-martin*—as a male hermaphrodite, while elsewhere he states his non-belief in hermaphroditism in mammalia. He is the most learned and scientific of all the observers, and his bibliography is most copious and cosmopolitan, as he quotes Latin, English, German, Danish, and French observers abundantly and to the point. He must therefore take rank in my opinion as a most celebrated medical and veterinary scientist. He also considered in clinical cases the question of a free-martin with a potent female and a non-potent one, and this is still a possible but as yet undemonstrated condition.

J. Y. Simpson discussed the question of the possibility of a human female co-twin with a potent male being sterile, and showed this was not the case. It is remarkable that so far as is known no free-martin exists in the human species where twins are born, but I believe it may occur as a single case and by another mechanism. In the human species boy and girl twins are from separate non-identical zygotes. The essence of identical twins† (normal or with one malformed) is that *one zygote gives rise to both, and that they are of the same sex*. Simpson's article is both cogent and scientific.

We now come to Spiegelberg, who wrote the most thorough and scientific paper yet published on this subject. His case was a calf free-martin with a co-twin potent bull, and he dissected and identified the structures in the peritoneum, examined the sexual glands and the structures near them microscopically, and identified the apparent double sexual glands as testes and Wolffian body. He identified and figured the following structures:—rudimentary Müllerian element of uterus; vesiculæ seminales; vasa deferentia; imperfect testes; rudimentary Wolffian body. His

* These terms are convenient.

† See paper by the author on "The Theory of Enzygotic Twins," *Edinburgh Medical Journal*, Oct. 1911.

conclusion on the testes is as follows:—"Da nun die betreffende Körper auf beiden Seiten hauptsächlich aus Canälen bestanden, so ist keiner von ihnen für einen verkümmerten Eierstock zu halten: sie sind vielmehr entschieden in der Entwicklung gehemmte männlichen Geschlechtsdrüsen. Es wird wohl am richtigsten sein, die Körper g* in anbetracht der Zartheit und des Verlaufs ihrer Canäle für die rudimentären Hoden, die nach aussen gelagerten h* wegen der Grösse ihrer Canäle, der Ausbuchtungen derselben für die Reste der Wolff'schen Körper zu halten."

MODERN VIEWS ON THE NATURE OF THE FREE-MARTIN.

The four great observers whose views have been detailed were hampered, as every generation of scientific observers usually is, by inadequate knowledge of facts or defect of methods. The defects of the knowledge of the time may be stated as follows:—

1. *Imperfect Knowledge of how Twins Arise.*
2. *Inadequate Appreciation of the Rudimentary Opposite Genital-Tract Elements in each Sex of Mammals.*
3. *Inaccurate Conceptions as to what Constitutes So - Called Hermaphroditism.*
4. *Mendel's Discovery had not yet happened.*

1. *Imperfect Knowledge of how Twins Arise.*—The chief ways in which twins arise are—

(a) From one zygote or fertilised ovum. This may give two identical and perfect twins, either male or female; one perfect male and one imperfect male twin, such as the free-martin in cattle; peculiarly deformed twins in man and other mammals, known as allantoido-angiopagous twins; and several other monstrosities.† The possibility of the free-martin and its potent co-twin arising from one zygote was not recognised till B. S. Schultze pointed out that identical twins arose from one zygote.

(b) From two separate zygotes, the resulting twins being of different sexes or of the same sex, and thus non-identical. This explains the puzzle to the old observers of a twin bull and cow calf both perfect in sex. Possible calf twins are therefore as follows:—

From One Zygote.—(1) Identical male twins; (2) identical female

* See his article or the author's paper "On the Free-Martin," *Proc. Roy. Soc. Edin.*, 1909-10.

† See author's paper in *Edin. Med. Journ.*, October 1911.

twins, both comparatively rare; (3) one potent bull and one imperfect and sterile bull, the free-martin common; (4) one perfect female and one imperfect female, not demonstrated yet, but theoretically possible.

From Two Zygotes.—(1) Two non-identical perfect males; (2) two non-identical perfect females; (3) one perfect male and one perfect female non-identical. It is this division (3) that gave ground for doubt until it was recognised that the free-martin and its potent brother arise from one zygote.

2. *Inadequate Appreciation of the Rudimentary Opposite Genital-Tract Elements in each Sex of Mammals.*—The existence in the human female of the epoophoron, the equivalent of the epididymis along with the characteristic potent organs (ovary, uterus, vagina) and the analogous presence of the hydatid testis and prostatic utricle (Müllerian and hymeneal) in the human male have been long known, but until recently treated as interesting but unimportant relics of a previous double sex in past times. They are of the greatest significance in the phylogeny of sex, but I only point out their bearing on the free-martin at present. It is now evident that the free-martin, co-twin with a perfect bull, has served out to it in the allotment from the one zygote, the rudimentary organs based on a female type, viz. the hydatid testis and prostatic utricle (single or doubled) of the potent bull co-twin. The whole anomaly arises in the early intrinsic mechanism in the earliest stages when the determinants of the zygote are doubled and segregated.

3. *Inaccurate Conceptions as to what Constitutes So - Called Hermaphroditism.*—It is the sexual gland that determines the diagnosis of sex. The rest of the genital tract, when normal, makes up an individual normally equipped for *effective sex*. The subject cannot be discussed fully, but no case of ovary and testes has been established as co-existing in a mammal, and the ovum figured by Blacker and Lawrence in their excellent and careful paper can be interpreted as a degenerated sperm cell in the debris of degenerated tubular epithelium. In the case of a six months' hermaphrodite pig-fœtus given by Sauerbeck* what he figures as ova might be considered as primitive sperm cells, but it is difficult to be certain from a drawing. Thus there can be no lateral hermaphrodite and no ovotestis. The free-martin has been called a transverse or female hermaphrodite, but it has vasa deferentia, vesiculæ seminales, and testes, and the lower part of the

* *Frankfurter Zeitschrift für Pathologie*, iii. 339, 1909.

genital tract is the developed rudimentary hydatid testis and prostatic utricle along with the urinogenital sinus. All this may seem dogmatic, but space prevents me giving the full evidence at present.

What requires to be kept in mind is (a) that the normal single mammal has in the genital tract non-potent opposite sex relics which are necessarily larger in the adult alleged hermaphrodite; (b) that the statements as to the existence of "ova" in the sexual glands of alleged hermaphrodites are quite untrustworthy, the alleged "ova" being more probably imperfect sperm cells in isolated and degenerate seminiferous tubules.

4. *Mendel's Discovery*.—The points in Mendelism applying to the free-martin are—

1. *The Autonomy of the Unit Characters.*
2. *The Theories of Dominance and Recession.*

1. *The Autonomy of the Unit Characters*.—The hydatid testis and prostatic utricle—the non-potent organs—behave like a unit character, and become segregated into the free-martin, thus giving it its degenerated and defective lower genital tract, necessarily from its origin, on a female type.

In the *Stiermartin* the non-potent organs are more represented and a rudimentary prepuce is present, while the testes are more evident and farther descended in one case of Numan's. The non-potent organs make up, as it were, one of the bricks of the human female, and any transposition is effected by it as a whole.

Whether or not the non-potent organs are doubled or transported singly is not known, nor do we know the condition of the upper poles of the testes or of the prostatic utricle in the potent bull of the twins.

2. *The Theories of Dominance and Recession*.—If one holds that these represent some actual significance, then the non-potent organs are to be classed as recessive, and I have discussed this in a previous paper.* I have come to see, however, that all that the term dominant means in a unit-character is that in a crossing it is expressed first in the somatic part of the zygote of F^1 , while the so-called recessive quality in a crossing with two contrasted characters is distributed in a probability ratio in the propagative part of the plant or animal of F^1 , and that the recessive being thus

* See *Proc. Roy. Soc. Edin.*, 1909-10; also the author's *Phases of Evolution and Heredity*.

interned *quâ* F¹ in its propagative part only appears expressed in the plant in F².

The essence of the free-martin is that it is one of twins, arises from one zygote, and has a potent male brother. It itself has defective testes and vasa deferentia and vesiculæ seminales like those of its brother, but has also for the rest of its genital tract the hydatid testis and prostatic utricle of the potent bull transferred to it. It is not a hermaphrodite or even pseudo-hermaphrodite, and is best described by its popular name, free-martin, as that involves no special theory as to its origin. We still need to know the condition of the internal sexual organs of the potent co-twin bull and of the remaining tract of the ox, as well as more definite facts in regard to the skeleton, etc.

Numan may be classed, if not ranked, with Sprengel, Mendel, and Couper,* men of great insight and genius, whose work was not appreciated in their time. They had, however, the joy and satisfaction of seeing natural processes clearly and in advance of their time, not as other men, and this must have been their consolation in their Cassandra-like fate.†

LITERATURE.

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Boardman. *Dictionary of the Veterinary Art*, 1805, Article "Calf."

Columelle. *Instruction sur la manière de conduire et de gouverner les vaches laitières*, Paris, 1807, p. 58.

Gurlt. *Lehrbuch der Haussäugethiere*, Berlin, 1832, Teil ii. S. 191.

Hunter, John. *Observations on the Animal Economy*, Scheller's Translation.

Jäger. *Beschreibung von Hunter's anatomisch pathologischen Museum des Collegium der Wundärzte in London, aus dem Englischen, mit Anmerkungen*, Erlangen, 1835, S. 73.

Meckel. *Archiv*, Bd. v. S. 136. Numan quotes authors who state that we may have a hermaphrodite deformity in human twins, and Meckel found them to be males. Sir Everard Home thought we might have a free-martin in human twins, but J. Y. Simpson disposed of this idea, and Meckel gave a case where male and female were both fertile, twins evidently from separate zygotes. Numan's opinion on this agreed with the one Simpson expressed afterwards.

* For Couper the chemist see *Proceedings of Royal Society of Edinburgh*, xxix. p. 193.

† Merz, in his most valuable *History of European Thought in the Nineteenth Century*, Blackwood & Son, Edinburgh and London, 1896, gives at vol. i. pp. 240-48, some interesting additional facts on this point.

He adds the interesting fact that the mule's ovary may contain 10-15 Graafian follicles.

Meckel. *Handbuch der Pathologische Anatomie*, Leipzig, 1812, Teil i. S. 14.

Naegele. "Beschreibung eines Falles von Zwitterbildung bei einem Zwillingpaar," Meckel's *Deutsche Archiv für Physiologie*, Bd. v. S. 136.

No case of strict free-martin, one of twins, has been recorded in the human species. Single cases analogous to the free-martin do occur, and I have already mentioned them. These I consider as due to a loss in the polar bodies at the time of the maturation of the primitive germ and sperm cell.

In Meckel's *Archiv für die Physiologie*,* v. 1819, S. 136, there is a remarkable case recorded by Naegele of Heidelberg, well known for his work on the Mechanism of Labour, Naegele Pelvis, etc.

Naegele states that in 792 recruits examined, three cases of genital deformities were found, and two of these were twin brothers. Their history is as follows:—When born they were regarded as girls and christened as such; after puberty they showed characteristics of the male sex, and therefore donned male clothing and undertook men's work.

They each had split scrotum simulating labia majora, each half with a testis, etc., and one of them had labia minora. Both had an enlarged and bound-down clitoris. When the labia were held apart a condition simulating the female vestibule and urethral orifice was revealed.

Halliday Croom (*Edin. Obstet. Trans.*, vol. xxiv.) has recorded an almost exactly similar case met in two brothers, 19 and 21, where the same initial mistake was made as to sex.

Naegele's case is unique so far as I am aware. The following is the explanation I offer:—

The case was one of identical twins, similar in development in almost every respect, and remarkable in this that each had exactly the same defect, viz. apparent labia majora (split scrotum), each labium with a testis in it; absence of the corpus spongiosum and no covering to the floor of the urethra, apparent labia minora being present except in the case of the second described, where they were wanting. They were not human free-martins.

I suggest the following in explanation:—

1. The one zygote (fertilised ovum) which gave rise to them was formed as usual by the union of two gametes (ovum and spermatozoon).

2. Each of these (in the sperm- and germ-cell condition) lost, prior to fertilisation, certain chromosomes, reducing the number of each to half that of the number necessary for the zygote.

3. In the chromosomes thrown off (polar bodies) were the determinants (hypothetical causes in the zygote for the adult organs) for the corpus spongiosum and those for the closing and uniting process of the structures forming the scrotum and urethral floor.

4. The remaining somatic determinants became doubled and segregated equally and laterally, thus giving rise to twins identical in their normal and abnormal conditions.

* Neugebauer in his *Hermaphroditismus* gives an abstract, p. 345.

5. Had the zygote determinants not doubled, a single so-called pseudo-hermaphrodite would have resulted, as in Croom's case of two brothers (19 and 21) already mentioned.

Sandford. *Medical and Physical Journ.*, xi.

Sebald, G. F. *Naturgeschichte des Pferdesausbach*, 1815. Numan adds a considerable amount of literature on genital deformities in the horse (*Journ. vet. et agricole*, 1844, pp. 125 and 126).

Spencer, Earl.* "On the Gestation of Cows," *Veterinarian*, 1839, p. 722, and 1840. In a note Numan says: "Chez nous on ne l'appelé kween que quand elle reste stérile. Hunter fait aussi cette distinction, et il nomme seulement *free-martin*, une femelle engendrée dans les mêmes conditions, mais qui ne procréé pas. Les anglais paraissent généralement appliquer la dénomination de *free-martin* à la femelle, qui naît avec un mâle de la même portée."

Varron. *De re rustica*, lib. ii. cap. v.

Weiland. Le mot "kween" servait à désigner dans les anciennes langues, qui ont une origine commune, une femme ou une ménagère. Les anciennes Germains nommaient la femme *quen* ou *quena*: les Suedois *qvinna*. . . . Les anglais ont aussi le mot *quean*, provenant de la même racine, comme terme de mépris, pour désigner une femme de mauvaises mœurs. . . . Le grec *γυνή* . . . bohémien *zena*, lusitanien *schená*, le polonais *zona*, qui sont être tous peut les derivatives du verbe *γεννᾶν*, engendrer: et auquel se rapportent chez nous, *kennen*, *bekennen* (connaître, reconnaître). En hollandais *Kween* désigne la femelle de l'espèce bovine, et plus spécialement une vache stérile. To this we may add that in "Scots" one may speak of a "saucy quean."

Youatt. *Cattle, Their Breeds, Management, and Diseases*, London, 1834, p. 538.

DESCRIPTION OF PLATES.

PLATE I.—FIG. 1 (reduced from Numan's Plate VI.).—He describes the animal as a speckled three-year-old *vaarskween*, i.e. a heifer free-martin, Hunter's free-martin.

FIG. 2.—Internal genitals of the above.

1. The vagina laid open; really the vaginal portion of the urino-genital sinus.
- 2, 2, 2. The broad ligaments; clumps of fat associated with sexual glands.
3. Urethral opening.
4. Opening of the left Gartner's duct.
5. Opening of the right Gartner's duct.
6. Duct of the uterus.
7. The incomplete cornua.
8. Fibrous strands connected with remains of blood-vessels and Fallopian tubes.
9. Cornua of Fallopian tubes.
- 10, 10. Great and small capitula of Gartner's canal; vesiculae seminales.
- * 11, 11. Gartner's canals; are really vasa deferentia.

* This was the third Earl Spencer (1782-1845), better known as Lord Althorp.

PLATE II. (Plate XII. of Numan's Atlas).—FIG. 1.—Two-year-old deeply-coloured stierkween.

FIG. 2.—*a*, anus ; *b*, perineum ; *c*, perineal cleft with prepuce ; the glans is perforate.

FIG. 3.—Internal organs of above.

- a*, Urethra opened.
- b*, Narrow junction of urethra and bladder.
- c*, Oblong groove passing into glans.
- d*, Contorted glans as in goat or ram.
- e*, Retracted muscle of the phallus.
- f*, Erector muscle.
- g*, Blind openings.
- h*, Vesiculæ seminales.
- ii*, Vasa deferentia.
- n*, Incomplete testes.

FIG. 4.—*a*, anus ; *b*, opening in perineum with part like female genitals projecting ; *d*, prepuce between male teats.

ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH, ROYAL COLLEGE OF SURGEONS OF EDINBURGH, AND ROYAL FACULTY OF PHYSICIANS AND SURGEONS OF GLASGOW.

THE quarterly examinations of the above Board, held in Edinburgh, were concluded on 22nd January, with the following results :—

First Examination.—The following candidates passed the first examination :—Anna G. Stott, Edinburgh ; John W. Robb, Forth, Lanarkshire ; Oswald C. Macdonald, Forfarshire ; Harry Morley, Edinburgh ; James L. Hendry, Aberdeen ; John P. Fairley, Leith ; Alfred D. Gorman, Methven ; and Jackson B. Minford, Temple-Patrick.

Second Examination.—The following candidates passed the second examination :—John Martin, Glasgow ; John B. Aickin, Belfast ; Harry A. L. Guthrie, Leith ; William MacLeod, Glasgow ; John Berry, Leyland, Lancs. ; Andrew F. Readdie, Edinburgh ; Thomas E. Lawson, Coventry ; and William S. O'Loughlin, Cheshire.

Third Examination.—The following candidates passed the third examination :—R. Kaushosh, India ; B. S. Raj, Hyderabad ; Maud Bennett, London ; William Bannatyne, Paisley ; P. C. Ray, Bengal ; Louis Lazarus, Natal ; Octavus W. Bateman, Cork ; Alfred G. Cowper, Bombay ; Charles Cosgrove, Sydney, New South Wales ; Devendra Bharadwaja, India ; Victor J. A. Wilson, Aix-la-Chapelle ; Charles L. Patch, Madras ; H. S. Dastur, India ; Richard Dorset, New Zealand ; and James Williamson, London.

Final Examination.—The following candidates having passed the final examination were admitted L.R.C.P.E., L.R.C.S.E., L.R.F.P.&S.G. :—Ernest Layton Matthew, Scotland ; Thomas Maitland Crawford, London ; Samuel Ethelbert Mangenie, Mauritius ; Gerald Irwin Secluna, Burma ; Arthur Lloyd Edwards, Penygroes, North Wales ; Royapuram Nellaveran Raja, Madras ; Cyril Scotter Owen, Hale, Cheshire ; Violet Eulina Field, Nelson, New Zealand ; Henry Watters Dunnet, Ottawa, Canada ; Charu Chandra Bose, India ; Alfred Meares Billings, Birmingham ; Hugh Sharpe Williams Roberts, Wales ; Romesh Chandra Mitter, India ; Henry Gilbert Lamberty, Mauritius ; and William John Herbert Davis, Liverpool.



