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OBSERVATIONS
ON THE
STATISTICS OF HERNIA,
AND
ON THE ANATOMICAL CAUSES
WHICH DETERMINE ITS PRODUCTION.

BY ROBERT KNOX, M.D., F.R.S.E.

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(*From the Edin. Med. and Surg. Journal, No. 128.*)

WHEN surgeons in extensive practice, or practical anatomists meet with a considerable number of cases of any particular disease, they are naturally apt to infer that such cases must be frequent: that in fact, what is seen by them must likewise fall under the cognizance of others. Having seen, for example, a considerable number of hernia cases occur some years ago in Practical rooms, the inference I drew from this was, that the disease must be comparatively frequent, a conclusion arrived at the more readily, that it accorded with what I had then read in valuable works, and what I had heard from distinguished practical men; but when I endeavoured to submit to calculation what I knew, so as to ascertain the ratio of such cases to others, or to the mass of the population generally, I soon found that all the elements of a sound statistical inquiry were wanting, in so far at least as my own observations extended. Reflecting next on what I had many years ago read and seen, a suspicion arose in my mind that the statements of medical writers on the question of the frequency of hernia, the ratio of cases occurring in any class of the general population, the numbers reducible to those irreducible, &c. would not bear inquiry; and that these statements generally, would turn out when scrutinized to be mere surmises like my own; mere conjectures, in fact, either totally useless, or as when put forth pompously with the semblance, but without the fidelity of real inquiry, worse than useless, as

misleading those putting confidence in them. In hopes of directing the attention of others more favourably situated than myself to this inquiry, I shall venture briefly to submit to the Society a few observations and reflections which have occurred to me.

If the predisposing causes of hernia were well understood, conjectures approaching to a useful approximation might be made, in respect to the greater liability of any part of the population to hernia; and though such approximations are never good, they yet supply the place of a more precise statistical account. But in respect to hernia, the medical works I have consulted do not furnish even this. No one I think, could venture to state from positive data known to him, whether hernia be more liable to affect the sedentary or the laborious, the wealthy or the poor, the young or the old; at least if data exist for the precise determination of these questions, I am not acquainted with them. Dr Monro in his admirable work on the Gullet, does, indeed, quote the records of the Rupture Society of London, as furnishing data for estimating the proportion of persons afflicted with hernia, and Mr Turnbull, surgeon to the Institution, states the average, as "1 to 15 male and female of all ages." But in order to judge of the accuracy of these data, the calculations should be before us; 1 to 15 is between 6 and 7 per cent. Now this average, judging from what I have accidentally seen in dissecting-rooms, I should at one time have thought not much over-rated, but mature reflection has shewn me the danger of trusting to such sweeping statements, got up without proper materials. Dr Monro thinks this average of nearly 7 per cent. to be the truth, although we have in his own work a statement of foreign recruits of the German legion examined by Dr Verstrum, and others, which runs thus: Number of recruits examined, 40,460; number rejected for hernia, 365, or less than 1 per cent.; and yet these Germans must have been generally drawn from the lower orders and poorer classes, who, aware that the exigencies of war were at that time pressing, must have been sensible that the inspector of recruits for the British service would not be over fastidious in his choice. Here, then, of 40,460 young Germans of the lower classes, the number of ruptured was not 1 per cent. Supposing the women and children of their population to have been ruptured in the same proportion, (which cannot even be imagined) we should still scarcely have $2\frac{1}{4}$ per cent. for hernia cases of all ages; this average contrasts singularly with 7 per cent., and still more with an average I have calculated from the results of the conscription of three years in the French service, which average gives a ratio of only $1\frac{1}{2}$ per cent. upon the whole male population.

The Memoirs of the French Academy of Surgery, furnish perhaps better data, as drawn from more varied sources

Received into the Salpêtrière	-	-	7027 women,
Of these were ruptured,	-	-	220 do,
Received into the Bicêtre,	-	-	3800 men,
Ruptured,	-	-	212 do,
Received into the Hotel des Invalids,	-	-	2600 men,
Ruptured,	-	-	155 do,
Received into the Hopital de la Pitie,	-	-	1037 young men,
Ruptured,	-	-	21 do.

These are the best data on record, and they give averages exceedingly low, compared to the general statements of surgical writers.

It is not even known if particular races are more liable to hernia than others, and in respect to nations the question is equally obscure. At this point, in order to be of any value statistically, the inquiry should commence, 1st, Are the dark races of men equally subject to hernia with the fair? I myself have never observed a case of hernia occurring in any unmixed dark-coloured savage race, although I have seen many thousand individuals; yet they lead an indolent life so long as they can; necessity then drives them to extraordinary efforts, as in the chase, which efforts they seem to meet with perfect impunity.

On the other hand, I am well aware that hernia frequently attacks mulattoes. In respect to nations, many are composed of the same race, although in very different states of civilization; some being mostly agricultural, others manufacturing, and others still nomade or pastoral: to ascertain in what respect these various conditions of life affect the great national masses would be exceedingly interesting. Medical men generally have attempted the determination of these questions, not by statistics, I fear, but by conjecture. The frequency of hernia in Switzerland was noticed by Freytag, (1721,) and by Blumenbach, who particularly singles out the district of Apenzell, as presenting numerous instances of this surgical accident. He gives many ingenious reasons why it should be frequent in Apenzell, but the first point to be determined is the fact itself: Is hernia more frequent in Apenzell than elsewhere? Is hernia more common in mountain districts (as some have asserted), for example in the north of Scotland and in Wales, and in some parts of Ireland, than in the extensive plains of England or of France? I am sure that myself and many others would be gratified to have pointed out to us the calculations upon which such statements have been made.

Mr Lawrence, a classical medical authority on hernia, says, that the accident is more common in the labouring classes of the community than in others; and for the same reason more frequent in the male than in the female sex; and on the right than

on the left side of the body. (p. 33.) All this is extremely probable, but then it is merely probable, no exact data existing in confirmation of these statements.

The inhabitants of the Cape never labour at all ; at least so it appeared to me in respect to the farmers on the northern and eastern frontier of the colony, and Mr Barrow has recorded the indolence of the colonists as incredible and extreme. In this respect I presume they act like other men ; there being no necessity for labour they very naturally avoid it. Yet they are said to be much subject to hernia. That I may not fall into the error just censured, of speaking and writing from no positive data, I had better mention the circumstance that first led me to notice the fact ; if correct, and of it I have little doubt, it proves that here is a healthy well-formed race who never labour, and who yet are peculiarly subject to hernia. I acted for some months as surgeon to a corps of yeomanry, perhaps about 900 strong, and composed almost exclusively of Dutch farmers and their sons, and of all ages ; one of these farmers a mulatto, however, claimed exemption from active service, on account of a large and pendulous tumour, growing from the inside of the thigh, and on examining this tumour, I also remarked an inguinal hernia. My report to the commanding officer, an affluent Dutchman, was, that I thought this man should not proceed with us, on two grounds, first, by reason of the tumour, and secondly, on account of a hernia for which he had no truss. The commanding officer cautioned me not to sanction the hernia as a cause, else we might have to discharge a third at least of the men next day ; for he verily believed that a third of the corps was subject to that troublesome accident to which he himself also was liable. Allowing the statement to be a little exaggerated, yet it argues a frequency of hernia in a race of men enjoying the greatest ease and comfort, almost without a parallel ; but they are very much on horseback, and to this perhaps may be attributed a complaint, which just now we have seen ascribed to labour. I ought to mention also their great disposition to corpulency. With the medical theorist we are forced to shift our ground, and next inquire into exercise on horseback as a cause of hernia.*

That hernia is frequent at the Cape where most persons ride much on horseback may be admitted, though in what proportion to the population or to other surgical diseases, it is impossible to say : but is it frequent amongst the Cossacks, the Tartars,

* To the credit of this corps of yeomanry, it ought to be mentioned, that none claimed exemption from service on the score of hernia, and very few from any cause whatever : even the individual above alluded to was not a pure Dutchman but of a half-breed. I have sometimes fancied that hernia is frequent in mulattoes, but my observations are not sufficiently extensive to warrant any conclusion.

the Mexicans, the Chilians, and the singular race of Poens, whose equestrian habits have been so often described? I am disposed to ascribe frequency of hernia at the Cape to other causes, and therefore, require it to be ascertained, that exercise on horseback does positively cause hernia in other nations; if it give rise to the accident with the Dutch, a Saxon race, it ought to produce the same effect with the nations and races just enumerated.

Many think that sedentary habits frequently occasion or predispose to ruptures; but the difficulty of getting at positive data is very great, for thousands have ruptures who never wear any truss, nor ever think of mentioning the circumstance to a medical man. Cavalry regiments are said to be ruptured in a much greater proportion than foot-soldiers, but in what proportion none has stated, so far as I know. Soemmering and Blumenbach, names respectable enough in science, ascribed the frequency of hernia amongst the Swiss and Dutch to their living so much on milk, cheese, and potatoes. Any remarks on such opinions seem quite unnecessary.

There is an anatomical structure which when present seems to me positively to predispose greatly to hernia, I mean great width of pelvis, and consequently increase in measurements of this cavity whether male or female. I remember examining the pelvis in a male who had double ruptures on each side, that is an inguinal and ventro-inguinal and femoral hernia on both sides; the size of the pelvis was much greater than is usually met with in the male, in fact it approached that of the female in all its dimensions, but before it was practicable to measure it when stripped of its soft parts, and then compare it with others, the specimen was lost. My impression was, that it nearly equalled in all its dimensions a full-grown female pelvis. Moreover, in two cases of strangulated crural hernia which I had occasion to see in the male, the pelvis in both was much larger than usual,* in fact it approached the female in its dimensions. I regret exceedingly that I had no opportunity of measuring the pelvis in these cases; but from what I have seen I feel disposed to think, that an unusual size of pelvis in the male is a frequent predisposing cause of inguinal hernia, and when extreme, even of crural hernia, which is not so uncommon in the male as some have supposed. The hernia had not been detected during life in the two cases I speak of, and they died in consequence of strangulation.

The ratio of hernia in respect to male and female falls next to be considered. Mr Lawrence says, (p. 33,) that from a Re-

* The hernia was on the right side for a reason I shall endeavour to explain immediately.

port of the City of London Truss Society for the year 1814, it appears, that of 7,599 persons to whom that institution had afforded relief from the period of its first establishment, 6,458 were males and 1,141 females.

The new rupture society had relieved 3,505 males and 565 females,* but I cannot consider this as affording any data for establishing the relative frequency of hernia in the sexes; it merely shews that more males apply for relief than females,—a circumstance every one must know very likely to happen in hernia.

In respect to the ratio of occurrence on the right or left side, the following table exhibits all I am acquainted with on the subject.

Tabular view of the comparative frequency of inguinal and crural hernia on the right and left sides.

Of 7,599 cases of hernia there were, of

Inguinal Hernia,	Males,	2567	Right side.	1469	Left side.
do.	Females,	20	do.	14	do.
Femoral Hernia,	Females,	264	Right side.	246	Left side.
do.	Males,	47	do.	38	do.

Ratio, according to the Report of the New Rupture Society.

Inguinal Hernia,	Male,	1563	Right side.	927	Left side.
do.	Female,	51	do.	34	do.
Femoral Hernia,	Female,	139	Right side.	93	Left side.
do.	Male,	19	do.	11	do.

It is right to remark, that trusses may have been distributed to those not affected with hernia but with swollen inguinal glands, an occurrence by no means unfrequent. I repeat, that I do not think that these reports, which have been so often quoted, are at all to be depended on in a statistical point of view. They furnish valuable data as to the relative proportion of the different kinds of hernia to each other, but none in respect to the average compared to the general population.

There is one ratio certain, viz. that males are most subject to inguinal, and females to crural hernia; but the exact ratio is not known from extensive data. All agree that the cause is the difference in the capacities of the apertures by which hernia descend being reversed in the sexes; the notion that any influence as to producing the accident of femoral hernia in the female is attributable to the comparative smallness of Gimbernat's ligament in them,† is without the slightest foundation, and is at once refuted by an appeal to a correct descriptive anatomy, which shows that Gimbernat's ligament is often larger in females than in males, and that its comparative smallness can never be assigned as a cause of hernia in them.

* Medical and Physical Journal, Vol. xxxi. p. 168, as quoted by Mr Lawrence.

† Monro.

It is denied positively that the great numerical disproportion between right and left ruptures depends on any disparity between the apertures of the two sides, and the difference has been referred by Mr Lawrence, M. Jules Cloquet, and by others, to the employment of the right side in those offices of life which require the most powerful exertion. Notwithstanding these, the highest authorities, I feel disposed to think differently, and to imagine that the cause really depends on the larger capacity of the right side of the pelvis compared with the left. Admitting the ingenuity of the explanation of M. Cloquet, that when we raise a heavy weight with the right hand, the abdominal muscles of the right side are both relaxed and put on the stretch by the action of the diaphragm and the pressure of the abdominal viscera, it yet occurs to me, that if we were about to raise a very heavy weight, we should use both hands, in which case the pressure on the abdominal rings would be equal or nearly so. On the other hand, it is a fact which admits of no sort of question, that the right side of the body has a strength and bulk superior in most persons to the left side, and this vigour extends even as I think to processes of healing, or at least of resisting disease, for I have often counted the ulcers on the limbs in large hospitals, and have always found them more numerous on the left than on the right side. It becomes then an interesting question, why, in respect to rupture, the stronger side of the body should shew a weakness.

I have already stated, that, in those having double ruptures on either side, an inguinal and ventro-inguinal for example, the pelvis, so far as I have observed, is uniformly of large dimensions. The same observation holds in respect to those males subject to crural hernia. I speak merely of what I have seen.

I next attempted to ascertain, by measurement, if the right side of the pelvis has a greater development than the left, and what ratio; but after several attempts I found it extremely difficult to prove by the compasses to how much the difference amounted. It was obvious that in the specimens examined, by far the greater number shewed a greater width of pelvis on the right side than on the left. I speak of the measurement from the *symphysis pubis* to the base of the anterior and inferior spinous process of the *ilium*; whilst in a few the left side was rather the wider, and in others the parts were quite symmetrical. I found the same discrepancies in regard to the *foramen obturatorium*. But there is a form of male pelvis, frequent enough, and which convinces me that there is a tendency to a greater development of the pelvis on the right side. The form of which I speak is one where the left *ramus* of the *pubis* descends almost straight to meet the corresponding *ramus* of the *ischion*, whilst

on the right side the ramus arches widely out, producing a singular want of symmetry in the arch of the *pubes*. The same want of symmetry happens not unfrequently with the clavicles, which may be the reason why, generally speaking, the surgeon finds more room above the right clavicle for the ligature of the corresponding subclavian artery than above the left, which not unfrequently is smaller, shorter, and less arched. I have subjoined outlines of the three extreme forms which the arch of the *pubes* assumes, figure 1st (Plate II.,) shewing the perfectly acute or pointed arch, a form, I presume, which induced M. Meckel to call it the "angle of the *pubes*" in the male; 2d, The rounded arch of the well formed female pelvis; 3d, The asymmetrical or hermaphrodite pelvis, in which the two sides are formed on different plans,—the right almost uniformly presenting a much greater capacity than the left side, but which difference, for obvious reasons, can scarcely be ascertained by actual measurement. This form of pelvis is by no means unfrequent in the male.

Of the comparative frequency of the different kinds of hernia, we have in authors some curious notices, and likewise some data which are more certain. In the former class I place a statement by Mr Marshall,* to the following effect. "Ventral and umbilical herniæ are commonly slight, and rarely affect the efficiency of the recruit:" Does this mean that a recruit may be passed though liable to ventral or umbilical hernia? It may also very naturally be asked, is umbilical hernia frequent in men, and in what ratio? In a future part of the work, Mr Marshall answers some of these questions, and offers some data for deciding on the comparative frequency of hernia in the lower orders of the labouring classes. I reckon recruits for the army amongst the labouring classes, although perhaps, those who ultimately join the army as private soldiers have previously laboured as little as possible. Of 6229 recruits, inspected from December 1824 to December 1825, Mr Marshall says, there were rejected for hernia 82, or about one and a third per cent. Of every 400 men, about five had hernia, a ratio at variance with all the more generally received notions, but which may, nevertheless, approach the truth, in respect to that class of persons who offer themselves as recruits. Of these 6229 recruits examined by Mr Marshall, there were also rejected for laxity or enlargement of both rings, 19; laxity or enlargement of the right side, 6; laxity or enlargement of the left do., 56;—a vast disproportion in favour of the left side, contrary to, and irreconcilable with the observations of all others, in regard to the actual greater frequency of hernia on the right side.

* Hints to Young Medical Officers, &c. London, 1828, p. 81.

There is also another singularity or two in these reports by Mr Marshall, which have struck me forcibly. Of the hernia there were, Inguinal, both sides, 1; right side, 14; left side, 17; ventral, 44; umbilical, 6. The greater frequency of hernia of the left side is at variance with the statements of Mr Lawrence and M. Jules Cloquet, and of all others. So far then the report of Mr Marshall is quite peculiar. The other singularity is the astonishing number of cases of ventral hernia (44,) a number greater I imagine than could have been seen by any three of the best employed surgeons in Britain. I am sure Surgeons would have felt exceedingly obliged to Mr Marshall if he had stated through what parts exactly these herniæ protruded; for such cases are but rarely seen by the profession; and I further take the liberty of recommending to Mr Marshall's attention, but in perfect good humour and without intending any offence, that chapter in Mr Lawrence's work entitled "On Fatty Tumours on the *linea alba*, resembling ruptures." The number of umbilical herniæ (6) occurring in active young men, equally surprises me. M. Cloquet dissected 457 cases of hernia, and amongst these were only 3 in men, "umbilicales et de la ligne blanche," in other words, of 457 cases of hernia, selected from many thousand dead, M. Cloquet met with three only in man, "umbilical and ventral." Of 82 cases seen by Mr Marshall, 50 were ventral and umbilical. Of 7599 cases relieved by the London Truss Society, there were only 44 ventral. We must leave to Mr Marshall the part of explaining these cases.

A second tabular view of recruits inspected at the dépôt Dublin, gives, out of 4018 inspected, 18 rejected for hernia, or a ratio of not one in 200 grown up adult males, in the prime of life, and of whom 3243 were approved as being of a sound constitution, and unexceptionably made in every respect.

A third report of 2588 inspected recruits gives 16 rejected for hernia. The total will stand thus :

Recruits Inspected	2588	Rejected for hernia,	16
	4018	- - - -	18
	6229	- - - -	32
	<hr/>		<hr/>
	12,835		116 a ratio under 1 per cent.

I confess I cannot refrain from asking the following question : Does it appear from these data that hernia is a prevalent disease ? * I once thought so, and with certain limitations, I

* Dr Monro says, "the importance of the subject must be apparent to every one who reflects on the prevalence of the disease." P. 864.

Chaussier estimates the ruptured at "le trentième des hommes." Arnaud, Juville, and Antonio Gimbernati at a fifteenth of the whole population in Italy and Spain, a twentieth in France and England, and a thirtieth in the north of Europe. The author of the Art. Hern. Dict. 1824, (Maret), thinks the first of these calculations exaggerated.

think so still. I believe hernia to be not uncommon amongst the really labouring and hard-working classes, but in what ratio it is impossible to say; whilst on the other hand, whole classes of society, those, viz. who do not labour, those who, whether rich or poor, live chiefly by the labour of others, are almost exempt from it. We have seen that those who offer themselves as recruits for the army in this country are remarkably free from this complaint. The following tabular view, drawn up from data in respect to the accuracy of which there can be no doubt, sets this fact also in a striking light. In 86 persons of the poorer but non-labouring classes of Society, and who had died of every variety of disease, and were examined with the most scrupulous attention to this fact, there did not occur a single instance of hernia of any sort. I subjoin their age and sex.

Tabular View.

<i>Males.</i>	<i>Females.</i>	<i>Males.</i>	<i>Females.</i>	<i>Females.</i>
<i>Ages.</i>	<i>Ages.</i>	<i>Ages.</i>	<i>Ages.</i>	<i>Ages.</i>
years 60	30	28	75	68
60	36	61	33	4
21	40	32	20	78
35	2	46	75	68
60	65	37	70	40
28	40	8	44	56
50	83	75	40	45
65	24	87	21	65
75	14	45	68	67
22	20	80	84	54
5	46	30	10	12
85	35	64	83	17
42	84	35	84	75
months 1	80	9	60	76
years 7	40	—	4	60
60	25	Total, 33	30	25
75	30		75	—
58	76			Total, 53
months 14	34		Total, 82.—Average age, male, 44	
	58		do. female, 58	

Remarks.—These cases were not selected, but taken consecutively and in one continuous period of time, during which, as may be observed, no case of hernia occurred. These persons were of the lowest orders.

Throughout these remarks, my object has been to shew, that the statistics of hernia have not been fully investigated. First, the average number to the whole male population is not known, nor the periods of life when it most frequently happens. Secondly, the same data are wanting in respect to the female population. Neither is it known what classes of the community are most liable to hernia; the precise influence of being much on horseback; the difference, for example, between the cavalry

and infantry of an army in respect to the frequency of hernia is still unknown.

A valuable fact has been stated by M. Jules Cloquet, viz. that of 8000 dead there were 457 cases of hernia* dissected by him, which dissections formed the materials for his valuable monograph on hernia. He in this way obtained the ratio which hernia cases bear to the total number of the unclaimed adult of both sexes who died in the great hospitals of Paris, but not of all ages; this would have required an examination of the records of deaths in the hospital of La Maternité.

The surgical statistics, if I may so say, of this disease, are not well known, and it is unreasonable to expect that they should be so. Few publish their unsuccessful practice. It was some years ago generally understood, if I rightly remember, that the continental surgeon was generally more successful than the British in his operations for strangulated hernia; and the fact, if it was so, was explained by showing that French surgeons bestowed but little time on the taxis, proceeding with the least possible delay to the operation for relieving the strangulated parts by incisions. All that I saw in the hospitals of the Hotel Dieu and La Charité of Paris, convinced me that these statements were well founded, and that French surgeons were extremely successful in cases of strangulated hernia which came to operation. I must not, however, refrain from mentioning here, that two Scottish provincial distinguished surgeons, Mr Crichton of Dundee, and the late Mr Turnbull of Dunbar, assured me that they had not in the course of a very long and extensive practice, met with a case of hernia irreducible by the taxis. Nothing but accurate hospital records can reconcile these conflicting statements. I think I have seen many cases of strangulated hernia altogether irreducible by the taxis. I observe by a late number of the *Lancet*, that Mr Liston now leans favourably to this side of the question; this distinguished operator thinks, that most cases of hernia may be reduced by the taxis. On the other hand, the continental surgeons I have met with are of opinion that, in this country, we trust too much to these means, delaying the operation so long, that, when ultimately performed, it merely hastens the patient's death. I could give numerous cases positively confirmative of these statements; and the frequent fatality of the operation for strangulated hernia was a matter of notoriety about twenty years ago in London, whilst its success in France was unquestionable, or at least unquestioned. Nothing but authentic, and in some measure official statistics of hospital practice, can put an end to these conflicting and ever-fluctuating opinions of surgeons, and relieve

* Dict. de Med. 1824, Art. Her. p. 84.

the young practitioner, under trying circumstances, from much embarrassment. The necessity for the occasional publication of "Anomalous Cases," might also be thereby done away with.

The ratio of the greater frequency of hernia in men than in women has been stated, but we have no proofs that so great a disproportion as 307 to 150 really exists; other data scattered through medical authors are not worth summing up. The tabular view I have submitted to the society, renders it probable that the very poorest classes are not more subject to the disease than those more fortunately placed in worldly circumstances.

Sailors seem to me a class of men much exposed to those causes which surgeons deem the efficient or exciting causes of ruptures; viz. sudden and great exertion, pressure on the abdomen whilst reefing the sails, &c. and likewise to hard labour, loading and unloading the stores, cargoes, &c.; but I have not heard that many are discharged for hernia from our service. The statistics, if they exist, have not been published.

To me it appears, that simple authentic records of any large hospital can alone decide most of these points, give a proper confidence to the young practitioner in respect to the steps he ought to adopt in these trying and difficult cases, and put the profession generally in possession of much useful information. Select clinical cases without doubt have also their value; they illustrate and extend pathology and physiology; and when fully authenticated, they impress the public favourably with the advantage, in a surgical point of view, of hospital institutions; but they cannot for a moment be put in competition with a plain tabular narration of the number of cases (without exception,) of any particular disease admitted during a given period; the numbers treated successfully without operation; the numbers operated on; the number dead in consequence. These views alone interest the profession generally. The former have but a limited and a local interest, and are sometimes even of doubtful utility.

Since writing these remarks I have consulted Sir G. Ballingall as to the question of the comparative frequency of the different kinds of hernia, and with his permission I subjoin his remarks. My reason for troubling Sir George with these queries was, that having been for many years a military surgeon on active service in all climates, and afterwards surgeon to a large civil hospital, a field for comparison had thus been opened to him, which must necessarily fall to the lot of few. *

Sir George first referred me to a passage in the Outlines †

* Sir George Ballingall is, so far as I know, the only surgeon who has had the candour and courage to publish an account of his successful and unsuccessful operations for strangulated hernia, including all cases, "anomalous" and others.

† Outlines of Military Surgery, by Sir George Ballingall, p. 347.

which had escaped my notice. He there states that "hernia cases are very rare in military life, and that for thirteen years he had no occasion to operate for strangulated hernia." I remember whilst surgeon to the Department hospital, Chelsea, I saw a good number of invalids who were ruptured, on their return from regimental service in the East and West Indies; but hernia must without doubt, as Sir George has remarked, be a rare disease in military life. This inference might also be drawn from the manner in which recruits are selected for the service, those being carefully rejected who show even a slight tendency to this ailment.

I next applied to Sir George for information respecting the statistics of the French, Prussian, and Russian armies, and he had the kindness to point out Isfordink and Coche as being the sources most likely to obtain information. My former pupil, Mr Gavin, had the kindness to examine the former of these authors and several others for me, but without any success.

The French armies being raised by conscription, and, as is presumable, from all classes, the service of their "recruitment" might be supposed an ample field for the decision of the statistics of hernia, in as far as regards the male population. But there exists a difficulty even here. Men of high spirit and delicacy, have been known to allow the conscription law to be put in force respecting them, preferring rather to conceal the circumstance of their being ruptured than claim exemption on such a ground. The following statement I copy from a very valuable though non-professional periodical,* which I peruse regularly with much pleasure.

French Conscription.

<i>Years.</i>	<i>Force of the class.</i>	<i>Exempted for hernia.</i>	<i>Averages.</i>
1831,	295,978	4,044	Force 286,429,
1832,	277,477	3,579	average cases of ex-
1833,	286,420	4,222	emption from hernia, 3,948.
			Ratio 1.3 per cent,

Ratio of rejection from all other disabilities, default of stature excepted, 6.7 per cent.

Whilst these sheets were going to the press, a friend (Mr Thomson) aware of my inquiries respecting hernia, furnished me with the following notice, which he copied from the Globe newspaper, of date April 13th. "The Rupture Society of London held a meeting last week. This society has been instituted since 1805. From the records kept by them, it appears one in fifteen at least (of both sexes) are affected with this complaint, and among such as are exposed to great bodily exertion, the average is one in eight or nine.

"31,400 cases have been relieved by this society since 1805."

* The Athenæum, No. 435, 1836.

These averages are completely at variance with those endeavoured to be established in the preceding pages. There are whole classes of society nearly exempt from hernia; the *very rich* for example, and also, as I think, *the mendicant by trade*.

Remarks on the lately discovered Microscopic Entozoa, infesting the muscles of the Human Body; with some observations on a similar animal found beneath the intestinal mucous membrane of the Horse. By Dr KNOX, Fellow of the Royal Society of Edinburgh, and Corresponding Member of the Royal Academy of Medicine of France.

1. DURING the winter of 1835, in the dissecting rooms of London, a microscopic entozoon was discovered, infesting the muscles of the human body, and various interesting accounts of the parasite were published in the Medical Gazette, first by Mr Hilton* who discovered the cysts, and secondly by Mr Paget, who discovered the worm inhabiting the cyst; and subsequently additional observations were made by Dr Farre, and Mr Owen.†

Since then, parasites of a very similar character, if not identical, have been observed in dead bodies in Ireland, and in France; but I am not aware that they have been as yet remarked in Scotland, until accidentally noticed in the practical rooms which I conduct.‡

Having observed them myself with very great care, and been aided by my brother, who is much versed in the examination of minute objects under the microscope, I have thought that the result of these observations might be interesting to the public generally, even although they should go no farther than to confirm the results of preceding inquirers.

The person from whom these entozoa were taken, had died of diarrhoea, and was about 65 years of age. There was nothing very remarkable in regard to her mode of living, excepting that the attending physician has characterized her as by no means over cleanly in her habits, or nice in respect to food; she was in fact rather gluttonous. She shewed during life no remarkable symptoms of debility, nor any appearance whatever of constitutional disease, whether scrofulous, venereal, or otherwise. The case being one in which delayed interment was permitted, afforded ample opportunities for the examination of every muscle, and indeed of every individual texture throughout; but after the

* London Medical Gazette, 1835.

† Trans. Zool. Soc. Vol. i. part 4.

‡ The cysts were dissected, and the contained parasites shewn by my brother to two or three hundred medical men, and specimens of the muscles so affected, were sent freely to all the scientific observers in town, desirous of having them.

most minute inspection, the cysts containing the parasitical worms, could not be found in any texture but one, viz. the cellular tissue surrounding the muscles of voluntary motion, and in the same tissue enclosing and connecting the muscular fasciculi to each other. The cysts enclosing the parasites lay with their long axis following the direction of the muscular fibres.

Cysts.—Although very numerous in many muscles, as in the pectoralis minor, the sterno-hyoideus, sterno-thyroideus, &c. there were yet very considerable intervals between them in general, and this is worthy of notice, because Mr Owen says that 25 were found in the *tensor tympani* muscle, a number almost incredible.

I shall first speak of the cysts enclosing the worms, certainly by no means the least curious part of the phenomenon. These are oval or egg-shaped, being rounded at their extremities, unless touched with an instrument.* They are composed of a rough granular looking membrane on the outside, and a smoother one inside; they are totally unlike cellular tissue, and are evidently not formed out of it, but actually constitute an essential part of the parasite;† but whether the worm ever leaves this cyst or not, and in what way it derives its nourishment through it, are matters entirely unknown as yet to naturalists.

The connexion of the cysts with the surrounding cellular tissue was this: They adhered strongly by the extremity, where the dark opaque spot is, at all other parts more loosely, particularly at the opposite extremity.‡

It is quite possible that the worm may at some period of its development abandon the cyst; in which case it would pass into the cellular tissue, and be lost to observation amongst its juices, for, being microscopic, it would be extremely difficult of detection in its new situation. The texture of the cyst is firm, elastic, crisp, and somewhat opaque throughout, but most so towards one extremity. The real structure of this extremity has not yet been made out. The cyst is easily lacerated with a needle, and from it the worm escapes by a little pressure; the worm does not seem connected with it in any way, but lies coiled or rolled up in a spiral manner, so as to occupy the smallest possible space. This circumstance of being rolled up is common to other parasitical entozoa, which have not cysts, such

* "Cysts of an elliptical figure, with the extremities in general attenuated." Owen, Medical Gazette, December 26th 1835.

† "The cyst is adventitious, foreign to the entozoa, and composed of the cellular substance of the body infested, morbidly altered by the irritation of the worm." Owen, p. 477.

‡ "The cysts are found to adhere to the surrounding cellular substance by the whole of their external substance, somewhat laxly at their more dilated part, but more strongly by means of their elongated extremities." Owen, p. 473.

as the entozoa of a similar shape, but infinitely larger, infesting all the textures of the *Clupea*, and likewise that more remarkable parasite found beneath the intestinal mucous membrane of the horse, and which I shall describe more carefully towards the close of these observations.

The worm.—By rupturing the cyst there escapes a small worm, cylindrical and filiform, obtuse at one extremity, and pointed at the other;* much resembling the *Vibrio tritici*, as represented by Mr Bauer in the Philosophical Transactions. It seems to live many days, and even weeks after the death of the person whose muscles it infests, and lives for a short time when removed from the cyst, gradually unfolding itself.† When crushed with a needle it is seen to be tubular, the contents of the tube differing from the outer case, and resembling a series of globules connected together by a central filament. But under a higher microscope, and when examined unbroken, the worm has a very different appearance. As under the same glass, and in equally favourable circumstances, the worm has presented to me very different appearances, I may be permitted to conjecture, that these differences are constant, and are perhaps referable to sexual differences. First, in some there is an appearance of a central or digestive tube, with numerous contractions like *cæca*, as has been very carefully delineated by Dr Farre; the same appearance presented itself to my brother and myself.‡ Or, secondly, the whole centre of the animal is observed filled with small globules. But it is quite possible that this second appearance may be merely the first structure not sufficiently made out. The head is rounded, and there is an evident appearance of a linear mouth or slit. The tail points rapidly, diminishing, and generally showing nothing of the darker central parts occupying the body of the worm higher up, whatever these may be ultimately determined to be.||

Position of the Parasite in the Body.—I have already adverted to the singular circumstance of these entozoa being found in the cellular tissue of the voluntary muscles only; but amongst them we must include some muscles not strictly voluntary, such as the diaphragm, intercostals, *levatori ani*, and constrictors of the pharynx. They were found in the lower margin of the inferior constrictor of the pharynx whilst the muscular fibres of the gullet below them were entirely exempt from

* Mr Owen says, "obtuse at both extremities," but he must mean comparatively.

† In respect to this I do not speak with certainty.

‡ In justice to Dr Farre's excellent paper on this entozoon, it is right to say, that my brother, in whose practical knowledge of the use of the microscope I have every confidence, leans entirely to Dr Farre's views in regard to the structure of the digestive tube.

|| We have never seen two worms enclosed in one case; but we have thought that some are rather smaller than others.

their presence. The same remark was made as to the fibres of the *levator ani*, and muscular tunic of the rectum. *

Pathological Effects.—When first discovered in human bodies, these worms were supposed to be the result of, or the cause of muscular debility; and conjectures of this kind were thrown out at the meeting of the British Association in Dublin, in 1835. These conjectures have been completely disproved.

The Natural History of the Worm.—A good account of the natural history of this curious parasite is extremely desirable, but the following considerations will show, that as yet scarcely any data of consequence have been collected.

1st, Its anatomical structure, has not been clearly determined.

2d, It is not yet known whether or not it ever leaves its cyst.

3d, The causes giving rise to it, and its mode of reproduction, are altogether unknown. As a mere conjecture, I venture to suggest that it is gemmiparous, and the granular-looking structure of the outer cyst may be the organs or mode of its reproduction.

4th, Even its proper position in the scale of animal being cannot be determined. An animal resembling one of the *Filariæ*, but living enclosed in a cyst, and as yet found only within it, and that cyst forming seemingly an essential and constituent part of the animal, is an anomaly even in this most anomalous class of all living beings.

I have only further to add, that on finding my first observations differ so much from contemporary observers, I have repeated them with every possible attention to accuracy, using glasses of very various powers (amongst others the Wollaston doublet) and modifying the light as much as possible, but have constantly arrived at the same results.

II. Of certain Entozoa found beneath the intestinal mucous membrane of the Horse.

On two occasions my friend Mr Dick has sent me portions of the large intestines of a horse presenting the following very singular appearances. The gut being simply laid open so as to exhibit the mucous membrane, a number of dark spots are observed, evidently exterior to the inner membrane, and seemingly imbedded in the cellular tissue. On examining these dark points with a glass of very moderate powers, they are found to be parasitical worms, rolled up in a spiral manner, very similar to the peculiar human Entozoa, described in part 1st of this memoir, but much larger. *They have no cysts, † and vary*

* Mr Owen (or Dr Farre) mentions their being found amongst the muscular fibres of the gullet, but, I should think there must be some oversight in the remark.

† I insist on this fact the more particularly, as it shows that the presence of an irritant in the living texture does not necessarily produce a cyst. The cysts enclosing the human entozoon are not formed out of the surrounding cellular tissue as some have supposed,

from the 10th of an inch to a length of at least $\frac{7}{10}$. They have a digestive tube divided into numerous compartments or sacculated; a mouth unarmed. The appearance which may have led naturalists to suppose the head *armed*, seems to me merely a rudimentary nervous system; viz. a cephalic ganglion, collar, and two nervous filaments proceeding from these. Along with the specimens, Mr Dick had the kindness to furnish me with the following interesting particulars. "I have found these worms, (Mr Dick remarks,) in several horses, and at different stages of their growth, from the size of a pin point, to that of an inch and a-half in length, and in two instances, in the blood-vessels. They seem almost always to produce a bad form of diarrhœa, and seem to depend on the food or situation in which the animal has been previously kept."

"The horses I have found affected with these, have always been running out previous to their becoming ill."

These remarks by Mr Dick, remind me strongly of what I observed at the Cape many years ago. On the north-eastern frontier of that colony, horses are generally turned out to pasture throughout the whole year; they run, as the phrase is, night and day, and indeed are seldom or ever under a covered stable. During the winter months, in consequence of the almost annual droughts, the pasture is very scanty, and at times thousands of horned cattle, and a proportionate number of horses, die of absolute want, the improvident farmer having nothing in store for them. The horses are at this time much infested with intestinal worms, which leave them spontaneously with the first showers of spring, these giving rise to a most luxuriant growth of herbage in an incredibly short space of time, and covering with the richest pasture, in a very few days, a vast range of country, over which a single blade of fresh grass could not a few days previous be discovered.

It was in the same colony that I observed the tape-worm, infesting the human body to an extent altogether inexplicable. The official facts have been recorded in the seventeenth volume (p. 384) of this Journal. Somewhat more than 2000 healthy men, mostly in the prime of life, were marched into Caffraria; they were undeniably the healthiest body of men I have ever seen. There was not a single person on the sick list. In two months thereafter, they became affected with tape-worm in the ratio of nearly 30 per cent. The disease attacked officers and men. As the climate was excellent, no assignable cause for this extraordinary endemic ever occurred to me, excepting the fact of their food consisting solely, during the greater part of the campaign, of bad bread and of still worse beef; the flesh of over-driven, starved cattle, and of a quality rejected even by the naked savages, the Caffres.

Thus it seems to me that unwholesome food may give rise to the generation of entozoa; but in what mode must be left I apprehend for future observers to discover.

Explanation of PLATE III.

Fig. 1. Natural size of the cyst.

2. Magnified view of cyst. *a*, extremity by which it adheres to the muscles, and slightly drawn out in consequence of this adhesion, which appearance disappears when the cyst has floated in water for a short time.
3. Magnified view of the cyst after the worm has been *successfully* turned out. *b*, the worm as seen through a lens of an inch and a-half focus.
4. Cyst greatly magnified after having floated in water for half an hour, when the prolonged extremity disappears.
5. Cyst partially broken up. *c*, the central part inclosing the worm remaining entire; an appearance frequently presented by those which had lain in alcohol for any length of time.
6. Greatly magnified view of worm when first turned out of cyst, assuming invariably (if allowed to float in water) the form seen in figure.
7. Expanded form of the worm.
8. A. Natural size of one of the intestinal worms, observed by Mr Dick, under the mucous membrane of the intestines of the horse: they vary, however, very much in this respect.
9. Magnified view.

These drawings were made from specimens sent me by Mr Dick on the 24th February 1835.

Fig. 10 and 11 Represent a similar worm, of which specimens were sent me in March 1836. It is worthy of notice, that both occurred about the same season of the year, when the pasture is in its worst condition.

12. View of the head and mouth, seen under a high magnifying power, with the appearance which some have considered as an armed head, but which, both from inspection and analogy, we deem the commencement of the nervous system. (See above, p. 18, line 3d.)

Fig. 1.

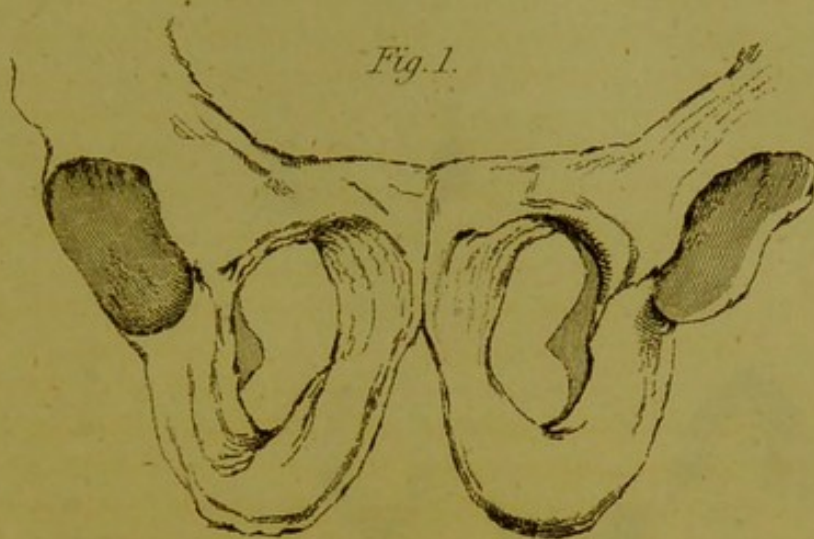


Fig. 2.

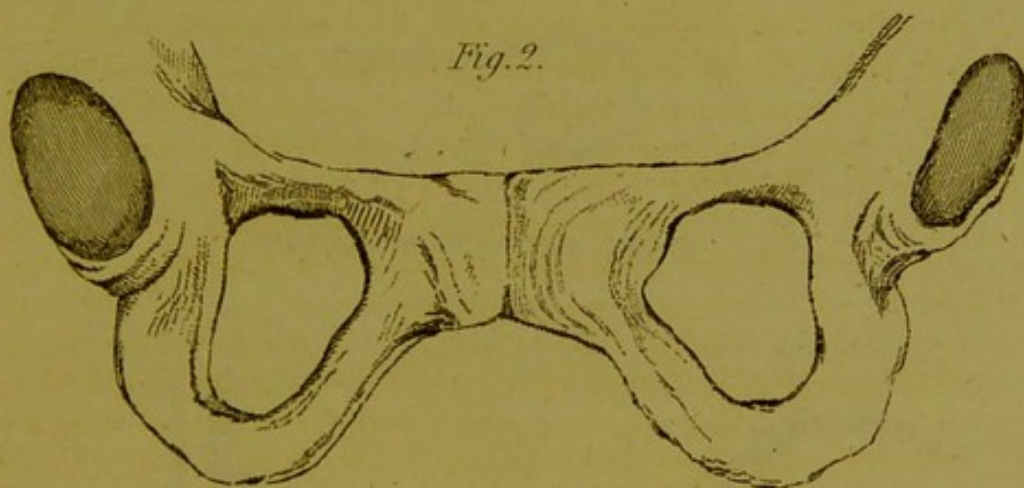
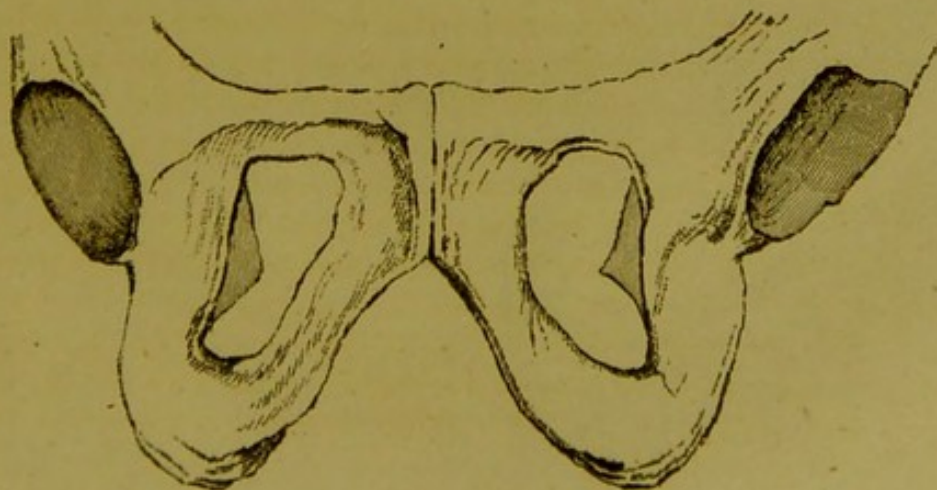
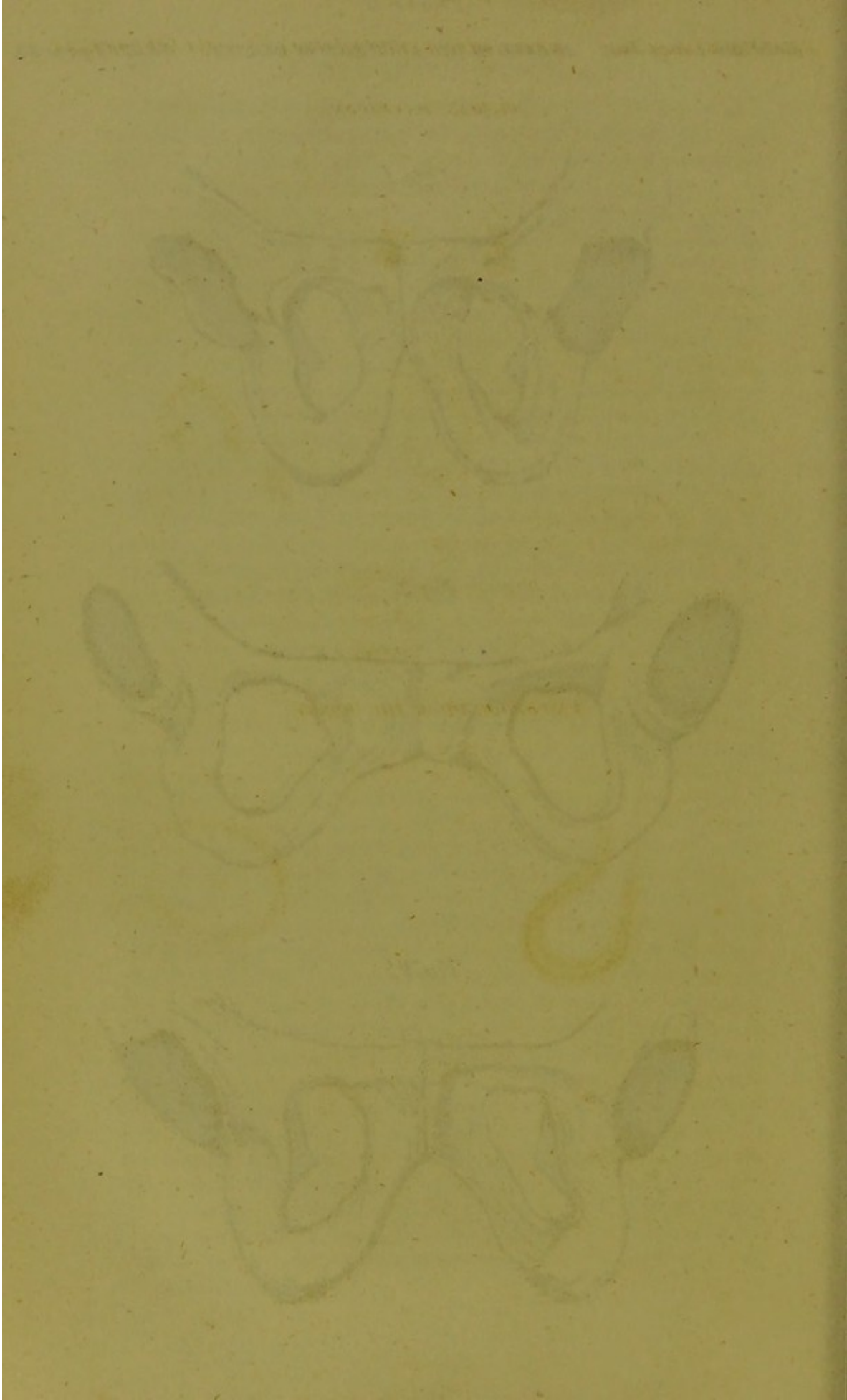


Fig. 3.





HUMAN ENTOMOZON.



ENTOMOZON FROM THE HORSE.



