Observations on the mechanism and diagnostic value of the friction vibrations perceived by the ear, and by the touch in peritonitis / by Robert Spittal.

OBSERVATIONS

ON

THE MECHANISM AND DIAGNOSTIC VALUE

OF THE

FRICTION VIBRATIONS

PERCEIVED BY THE EAR, AND BY THE TOUCH IN PERITONITIS.

By ROBERT SPITTAL, M.D., F.R.S.E,

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS, AND LATELY PHYSICIAN TO THE ROYAL INFIRMARY OF EDINBURGH; PHYSICIAN EXTRAORDINARY TO THE QUEEN IN SCOTLAND.

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ON THE FRICTION VIBRATIONS IN PERITONITIS.

(Read before the Med.-Chir. Society of Edinburgh, 5th February 1845.)

Friction signs in the early stages of Peritonitis have, during the last ten years, occupied the attention of several authors. They have not, however, been phenomena of frequent observation—probably from their having been rarely sought for; and it may be remarked that M. Piorry, in his recent work, "*De Pathologie Iatrique ou Médicale*,[1] states, that Messrs Barth and Roger, whose researches in auscultation are well known, had never met with them, nor had he himself been more fortunate—a circumstance sufficiently remarkable when we consider the ample field for observation enjoyed by these gentlemen, to whom medical science is indebted for much that is of the highest value connected with the diagnosis of diseases by sound.

The first notice of the friction indications in Peritonitis occurs in the work of M. Piorry, *De la Percussion Médiate*, &c.,[2] in which the author remarks, that Laennec was of opinion that "recent inflammation of the peritoneum gives rise, on the movements of the patient, to a sound like to that of parchment which is crumpled;" and in his more recent work, he reiterates a similar statement.[3] This observation, which is not to be found in the works of Laennec, M. Piorry became acquainted with at the Clinique of the latter, thus affording one proof more of the extraordinary comprehensiveness of mind, and unwearied powers of research, of the great discoverer of auscultation.[4] In June 1834, M. Désprez communicated to the Anatomical Society of Paris, "some details in regard to the auscultation of the abdomen in Peritonitis. He thought that in the early periods of the disease, and before any liquid effusion had occurred, a leather creaking, or sound of friction, analogous

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[1] Paris 1841, p. 304. [2] Paris 1828, p. 174. [3] Op. cit. p. 304.

[4] In an interesting communication which I had recently the honour of receiving from M. Piorry, he informs me,—"Ce n'est pas dans un livre, c'est à la clinique de Laënnec que j'ai appris que cet illustre observateur avait appliqué au diagnostic de la péritonite son admirable découverte. Il avait dit en effet à qui avait voulu l'entendre que dans des cas ou les surfaces contigues de la séreuse abdominale exercaient des mouvemens l'une sur l'autre, et alors quelles étaient le siége d'exsudations plastiques inégales et rugueuses, on entendait un bruit de frottement tres marqué. Il est évident que cette proposition contient tous les élémens de ce qui a été fait depuis sur ce sujet. Cest avec une véritable satisfaction que j'ai vu ma note rendre à *Laennec* ce qui appartient à *Laennec*, car j'ai publié mon ouvrage et par consequent j'ai fait la citation dont il s' agit bien avant tous les travaux sur ce sujet. Il m'eut été facile de parler du fait sans en indiquer la source; mais j'ai laissé à d'autres le soin d'en agir ainsi. Ma citation prouvera j'espére que personne plus que l'auteur de la plessimétrie n'a rendu justice à Laennec, dont il s' honore d'avoir été l'elève."—Paris, le 20 Fevrier 1845.

to that of pericarditis, could be heard." And at a subsequent meeting of the same Society, he "presented a large coagulum of blood, which had caused complete obliteration of the vena portæ, in a subject who had sunk under ascites. The spleen was large, and the vena cava inferior presented at many points small osseous concretions in the form of thin micaceous plates, which, by their sharp and curved edges, bent towards the concavity of the vessel, had raised the internal membrane of the vein. It was in this patient that M. Désprez heard the *bruit de cuir* in the commencement of recent peritonitis, following tapping for ascites, and of which traces were still to be found."[1] Meagre as are the details of this case, I have thought it worthy of quotation, as the earliest on record, in which the friction indication had been noticed in connection with peritonitis.

The first observations in this country were published by Dr Beatty in September 1834.[2] These were succeeded by the more ample details communicated by Dr Bright in 1835;[3] and in the two following years appeared the able critical analysis of previous observations by Drs Corrigan,[4] and Stokes.[5] The latest researches on this subject appear to have been made by M. Désprez, to whom I have previously alluded, and who made the peritoneal friction indications the subject of his inaugural dissertation.[6] Other writers have noticed the phenomena about to be considered; but the above appear to be the only authors who have recorded original observations: to these I now add the two following cases, which seem to embrace and elucidate points of interest either not hitherto known, or insufficiently considered.

Case of Phthisis Pulmonalis, Complicated with Bronchitis and Peritonitis.—A— P—, aged 31, a tailor, labouring under incipient phthisis, was admitted into the Royal Infirmary of Edinburgh on the 14th of July 1841, where he remained till the 2d of November, when he left the hospital, somewhat relieved from the more urgent symptoms of his disease. In *five* days, however, he again presented himself, in consequence of an aggravation of his complaints, and he was accordingly readmitted into one of the wards then under my superintendence.

It is not my intention to go over all the details of the case, which do not equally bear on the object of this communication; suffice it to say, that attended by the ordinary symptoms and physical indications of phthisis and severe bronchitis, the case continued

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[1] Arch. Gén. de Méd., Bull. de la Soc. Anatom., T. v. Paris (June and July) 1834.
[2] Dublin Med. Jour. vi. p. 146. [3] Med. Chir. Trans. xix. p. 176, London.
[4] Dublin Med. Jour. ix. p. 392, 1836.
[5] Diag. and Treat. of Diseases of Chest, p. 146, Dublin 1837.
[6] Traité Pratique d'Auscultation, &c. Barth and Roger, p. 514, Paris 1844.—I regret that after repeated attempts I have been unable to obtain M. Désprez' essay.

evidently progressing rapidly towards an unfavourable termination.

On the 21*st of January* 1842, he became affected with a subacute attack of *peritonitis*. He complained of pain, increased on pressure, across the abdomen, which symptom, with acceleration of the pulse, continued more or less till the 10th of February, when the following was the condition of the patient. The abdomen was somewhat tumid, occasionally tense and tympanitic, and fluctuation was distinctly perceptible at the most dependent parts. He complained of pain, generally over the abdomen, increased on pressure, and especially so in the epigastrium ; there was also pain in the loins on the motion of the trunk, or on pressure there. The bowels were freely moved after medicine ; the urine was said to be scanty, but its quantity could not be ascertained ; its sp. gr. was 1030, and was not coagulable by heat or nitric acid; pulse 88, of tolerable strength; skin about normal heat; tongue slightly furred and rather dry; much thirst and impaired appetite. At this time the cough, which had been severe and the breathing difficult, and more thoracic than usual, were somewhat easier, and the expectoration, which sometimes reached ℥xx, in twenty-four hours, amounted only to ℥v, of a tenacious, greyish-yellow mucus. After cupping to the loins, and leeching to the abdomen, the pain in both these regions was diminished, although by no means removed. He had suffered from a severe twisting pain in the abdomen occurring in paroxysms several times during the previous night.

On the 12*th Feb.* after free motion of the bowels, he felt considerable relief to the abdominal pain, which was now manifest chiefly on pressure in the umbilical region.

On the 14*th*, he had constant pain in the left hypochondrium, increased on pressure, and sometimes exceedingly severe. Percussion there was tympanitic. The pain in the umbilical region had now almost disappeared after leeching ; and on the 16th, after the same means applied to the hypochondrium, the pain of the abdomen was still less. The urine was reported to have increased in quantity, but could not be measured.

On the 17*th*, the fluctuation was observed to have diminished, while the tympanitic distention had increased, and in the morning the abdomen was tense and hard ; about mid-day, however, it had become more flaccid, and considerably reduced in size. *In the upper part of the abdomen, and especially in the umbilical region, a continued, gentle rustling, or soft jerking, rubbing sound, was heard on the application of the ear or stethoscope, varying in intensity, and frequently mixed with borborygmi.* He still complained of general uneasiness in the abdomen, increased on pressure, particularly in the umbilical region, and his thighs were drawn up towards the abdomen, which position, he stated, gave him relief. The pulse was 88, and of good strength.

On the 19*th*, the abdominal pain and swelling still continued, along with general tympanites ; but on lying on either side, dulness

upon percussion, and fluctuation were perceptible in the most dependent parts. *The rustling sound had rather diminished in intensity in the umbilical region, but was still distinctly heard generally over the abdomen, and at some parts very loud. To the touch there was a peculiar sensation, giving the idea of a continued soft creeping, or gentle vibration, under the fingers. These indications were not perceived where the fluctuation was felt; but on the patient lying on the opposite side, so as to admit of the removal of the fluid by gravitation, and the peritoneal surfaces to come in contact, they became perceptible.* The pulse was 92, and soft.

On the 21*st*, there was very little pain of the abdomen; the distention had diminished, and the stroke-sound was less tympanitic. As he lay upon his back, slightly inclined to the left side, there was an obscure sense of fluctuation across the abdomen, but very distinct in the depending side. *No rustling sound nor tactile vibration could now be perceived, and very few borborygmi, and the respiration was more abdominal than hitherto.* The pulse was 92, and of improved strength.

On the 23*d*, the stroke-sound of the abdomen generally, was duller, except at the uppermost fourth of the abdomen, when lying on his right side, where the sound was clear, and an *occasional slight degree of rustling was heard; and about the edges of the left false ribs a more prolonged sound, similar in character, but louder and synchronous with inspiration and expiration, was perceived.* The patient died about 10 P.M. of the same evening. As a point of the history of the case bearing upon the peritoneal complication, it is proper to add, that previous to his admission into the hospital, the patient became affected with an inguinal hernia of the left side, which proved a great source of annoyance to him, during his severe and protracted illness. He attributed it to the severity of the cough, and, during the latter part of his career, the hernia had very much increased in size from the same cause.

Examination of the body was made about 40 hours after death. *Thorax.*—The upper parts of both lungs contained a considerable quantity of tubercular matter in different stages, together with a few small cavities. In the right the tubercles were of a blackish colour,—emphysema was present in the anterior edges of both lungs.

Abdomen.—Upwards of four quarts of a greenish, clear, serous fluid were found in the peritoneal sac, containing, in the most dependent portions of the cavity particularly, numerous small shreds of lymph. On many points of its surface, the peritoneum of the intestines and mesentery, was covered with a thin, soft, easily separable, brownish-yellow layer of lymph; but generally speaking, it was free from this. The peritoneum, especially that portion lining the anterior and upper part of the abdominal parietes, was slightly injected with blood, and this was also observed in several points on the peritoneum of the intestines, although in a slighter degree. The *liver* was generally of a dark purple hue and more

evidently granular than usual; some of the granules being pale, but most of a dark colour. It was about the normal size; the *kidneys* appeared healthy, and no other morbid conditions were observed.

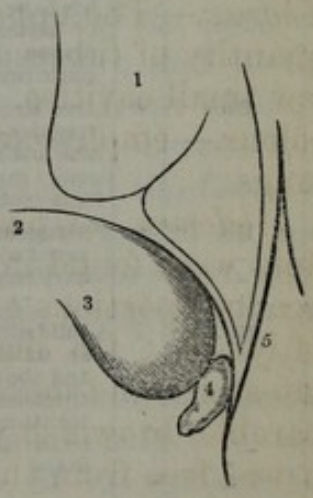
In the case just read, I have, for the sake of brevity, omitted the details of a therapeutic nature generally; and very much curtailed those concerning the pathology of the chest, it being my wish to submit to the Society that portion of the case relating to the peritonitic complication.

Through the kindness of Dr Bennett, I am enabled to add the following notes of a case which recently came under his notice in the Royal Infirmary. The patient, A—— M——, a labourer, aged 40, admitted into the hospital on the 19th December 1844, stated that about five weeks ago, he became affected with considerable pain in the left hypochondriac region, extending to the other side, and from thence generally over the chest, accompanied by dyspnœa, cough, and expectoration. On admission he complained of a "*pricking* or *sticking*" pain in the left lower lateral region of the thorax, with cough and muco-purulent expectoration. On the 21st he felt easier, but still complained of lancinating pain in the lower part of the left side of the chest, increased by pressure and by coughing. His sputa were muco-purulent and frothy. *In the region of the chest complained of, a rubbing sound was now heard, and towards the lowermost portion of that region, the sound ceased to be perceived.*

On the 22*d*, there was acute pain immediately under the left false ribs anteriorly, increased on deep inspiration and on pressure, and he could not bear percussion thereon. *On listening with the stethoscope, a very loud, double friction sound, of a leather-creaking character, synchronous with inspiration and expiration, was heard.* The patient died on the morning of the 23d.

Examination of the body. Dec. 24.—*Chest.*—Slight tubercular disease existed at the apex of both lungs, with some old firm adhesions between the pleuræ.

Abdomen.—Between the left lateral and anterior portion of the diaphragm, the upper part of the spleen, and great extremity of the stomach, a small space or cavity, was found, as in the accompanying diagram,[1] containing about ℥i of pus. The surfaces of the diaphragm, spleen, and stomach, to the extent to which they contributed to form the cavity, were coated with a recent layer of lymph, and united together by the same means. On the surface of the spleen there was a depression, which might have admitted the point of the little finger, also coated with lymph.



[1] Explanation of Diagram.—1. Lung, 2. Diaphragm, 3. Stomach, 4. Spleen, 5. Cavity, in a line with figure.

This case possesses peculiar interest from the great difficulty which it presented in the diagnosis, owing to the site of the peritonitis giving to the affection so much the physical characters of dry pleurisy, as perhaps, scarcely to have been distinguished from it by the most careful examination.

In the following table, the principal facts, bearing upon the diagnosis of peritonitis by the friction indications, have been collated as shortly as possible, from all the cases on record, so far as my research has gone.

TABLE OF CASES OF PERITONITIS, IN WHICH FRICTION VIBRATIONS HAVE BEEN PERCEIVED.

No.	Authors.	No.	Tumour or not.	Condition of Peritoneum, &c.	Tactile Vibrations.	Audible Vibrations.	Mechanism.
I	Desprez. June and July 1834.		Spleen considerably enlarged.	Traces of recent peritonitis.		Bruit de cuir ou de frottement.	
II.	Beatty. Sept. 1834.	1	A hard unyielding ovarian tumour filled abdomen from pubes to sternum.	Recovery — inflammatory indications subsided, and with them the friction signs.	Sensation of a grating, or rubbing together of two uneven and rather dry surfaces.	Loud and distinct frottement.	Most evident by full inspiration, causing abdominal parietes to move more freely over the surface of the tumour.
III.	Do.	2	Great inflammatory enlargement of spleen.	Recovery —friction signs ceased on inflammation being arrested.	A creaking sensation.	A creaking sensation.	Same as above (?)
IV.	Bright. 1835.	1	Large fungoid, lobulated, soft, and spongy tumour, attached to stomach, and descending to pelvis.	*Died July* 30.—Strong adhesions between peritoneum of parietes and tumour—latter slightly attached to viscera by recent adhesions.	A kind of crepitus.—*July* 8.		
V.	Do.	2	Large, irregular, semi-solid ovarian tumour.	*Died* 31*st Dec.*—Parietes of abdomen adhered generally to tumour.	A slight crepitus, or like the crackling feel of new leather.—*Feb.* 24.		By making the parietes of abdomen move gently.
VI.	Do.	3	A soft, uneven, and spongy tumefaction, supposed during life to be a mass of serum and fibrine. No organic tumour.	*Died Nov.* 22, 1834.—Parietes of abdomen universally adhered to the intestines by organized cellular membrane.	A kind of crepitus *July* 25, 1830.—continuing for some time.		Upon pressure.
VII.	Do.	4	Liver small and irregular—right lobe had a hard semi-cartilaginous coating.	*Died June* 1834.—Colon and omentum adhered to parietes of abdomen.	Slight sensation of crepitation over liver and omentum. *April* 1832.—Indistinct after 2 or 3 days.		
VIII.	Do.	—	Peritoneum covered with miliary tubercles.	Recent adhesions between intestines and parietes.	Crepitation.		
IX.	Do.	7	A solid substance at umbilicus; and above, the thickened omentum formed a resisting mass.	*Died June* 12.—No *post mortem* examination.	Sensation as when finger or hand is rubbed over a damp pane of glass, or other damp polished surface. *May* 4.—Crepitus. *May* 7.—Crepitus like deep-seated emphysema, rather than crackling of leather. *May* 18. Soft crepitus over lateral part of abdomen on both sides. *May* 21.—Soft crepitus below navel. *June* 1.		By placing the hand firmly on one side of the abdomen, as the mass of intestines was made to move by gently pressing with the other hand on the opposite side.—*May* 4. On pressure.—*May* 7.

No.	Authors.	No.	Tumour or not.	Condition of Peritoneum, &c.	Tactile Vibrations.	Audible Vibrations.	Mechanism.
X.	Hutchison. 1835.		Enlargement and induration of the omentum, mesenteric glands, spleen, and pancreas, and thickening of colon.	Adhesions of parietes and diaphragm to liver, omentum, arch of colon, and small intestines: the latter adhered to one another.	Crepitus *six weeks before death.*		
XI.	Corrigan. 1836.		Large irregular, medullary, ovarian tumour.	*Died Oct.* 16.—Parietes opposite tumour covered with rather firm, rough, spongy lymph—no adhesions.	A creaking sensation, resembling the creaking of new leather, (*June*) till death, with varying intensity.		By pressing the abdomen with the hand in situation of tumour.
XII.	Stokes. 1837.	1	Inflammatory tumefaction of liver.	Recovery, with cessation of the signs.		Intense friction sound over hepatic tumour.	On deep inspiration.
XIII.	Do.	2	Inflammatory tumefaction of left lobe of liver.	Recovery, with cessation of the signs.	Intense friction signs of descent and ascent over tumour.	Intense friction signs of descent and ascent over tumour.	On taking a deep inspiration, and depressing the diaphragm.
XIV.	Author.		Sub-acute peritonitis—no tumour.	*Died Feb.* 23.—Peritoneum partially covered with a thin layer of recent lymph, and slightly injected with blood. No adhesions.	A continued creeping sensation, or gentle vibration under the hand.—*Feb.* 19.	A continued gentle rustling or jerking rubbing sound.—*Feb.* 19. Occasional slight degree of soft crumpling sound.—*Feb.* 23. A prolonged sound, similar in character, but louder, about cartilages of left false ribs.—*Feb.* 23.	By the intestinal peristaltic motion. By do By respiratory movements; the sound being double, and synchronous with inspiration and expiration.
XV.	Bennett.		Surfaces of a portion of the diaphragm, stomach, and spleen.	Peritoneum of affected parts covered with a recent layer of lymph partially uniting these organs.		Double friction sound of a leather creaking character.	By respiratory movements—sound synchronous with the inspiration and expiration.

In the *second column* have been placed the *names of the authors*, with the dates of the publication of their observations; and in the *third*, the *number of the case* as it occurs in the works from which I have quoted, that easy reference may be made to the observations themselves. In the *fourth column* have been recorded the facts in regard to the *existence or not of an abdominal tumour*; and as this is a point which seems to have stood in the way of more extended research, it will, perhaps, be useful to analyse the observations on this subject still further.

Out of the *fifteen* cases in the table, *a large abdominal tumour* existed in *four*; the *liver*, or at least the peritoneal surface of this organ, had been *inflamed* in *four*; the *spleen*, or its surface, *inflamed* in *two*, probably in *three*—but the particulars of M. Désprez' case are not given—and *enlarged* in *two*; the omentum alone, *thickened* in *one*; the *omentum* and *intestines thickened* in *one*; a

soft, *uneven*, *spongy tumour*, probably from serum and fibrine, in *one*; *miliary tubercles* covered the peritoneum in *one*; and simple recent peritonitis, with a *partial*, *thin*, *soft*, *coating of lymph* was observed in *one*. So that, from these cases, it appears that a *true organic tumour* had only been present in a *minority*. If, however, those in which either the *liver or spleen* was affected, and which no doubt presented an analogous physical condition, be included, then a *majority* of the cases may be said to have had *one at least of the inflamed peritoneal surfaces adherent to a solid resisting body*; which circumstance, we agree with Dr. Stokes in considering favourable to the development of the friction vibrations,[1] although not necessary for the production of the latter, as was first pointed out by Dr. Corrigan;[2] but which is still more clearly proved by the case (No. 14) I have had the honour of reading, which was, so far as the peritonitis is concerned, less complicated in its character than any other in the table.

In the *fifth column*, the facts having reference to the *state of the peritoneal surfaces*, and whether *adhesions existed or not*, have been stated, from which it appears, that of the *fifteen* cases, after deducting *four* in which recovery took place, and *one*, the details of which are imperfect, *adhesion of the peritoneal surfaces* occurred in *seven*. But to show of how little value this evidence is in favour of the suggestion, that the friction vibrations are diagnostic of the existence of adhesions, it may be remarked, that of these *seven* cases, the *post-mortem examination* of *one* took place *upwards of four years* after these indications had been perceived; *one* nearly *two years* after this; *one* about *ten months*; *one six weeks*; and *one twenty-two days*. In *one* case only did the patient die within *twenty-four hours* after the perception of the friction signs; so that, with this exception, the evidence of all the *seven* cases, in which adhesions had occurred, is insufficient to prove, that, although adhesions were found on dissection, they were present at the time when the friction vibrations were perceived. Dr Bright's observations as a whole, rather tend to an opposite conclusion—though, in some instances, his diagnostic remarks are stated in a hesitating manner[3]—and it is to Dr Corrigan that we are indebted for first proving the unsoundness of this doctrine, and pointing out the importance of his views in practice.[4] The latter author, however, appears to me to adopt this opinion too exclusively when he not only says, that "this sign (friction indication) is not necessarily connected with the existence of adhesion, *but so long as the creak continues to be felt, adhesions are not formed.*"[5] This is a point open for investigation, and, in the absence of all proof, we may be permitted to doubt the accuracy of the remark, especially when we consider the facts which present themselves in regard to adhesions

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[1] Op. cit. p. 476. [2] Dublin Medical Journal, v. ix, p. 397.
[3] Op. cit. p. 177. [4] Op. cit. p. 397-400. [5] Op. cit. p. 400.

of the serous surfaces after inflammation. It is not always that we find these surfaces so universally and intimately united as to impede all motion reciprocally of the one upon the other, though it may be very much limited. But this we know does occur, as well in the case of the pericardium and pleura, as in the peritoneum; and in such instances, we should not expect the development of any friction vibration. On the other hand, when the adhesions are much interrupted by spaces without any union, although coated with lymph, it is evident that friction motion may occur by one or other of the mechanical causes to be afterwards noticed. And even, although the adhesions be general, and the adherent spaces few and small, still the yielding nature of the soft, recent lymph, it appears to me, might be sufficient to allow of the physical conditions proper for the production of the friction vibration,—for a time, at least, before it had intimately united the surfaces together,—it may be however of diminished intensity. The amount of motion necessary for the production of the friction sound, seems to be very limited, if we may judge from the simple experiment of bending *two* portions of dry and somewhat stiff leather—*not necessarily new*—closely applied to one another; or, by very gently rubbing the glazed surfaces of thinner leather together. In both instances, the degree of motion of the one upon the other is very trifling, and, in the first case, hardly perceptible, and yet the creaking vibrations are distinctly enough perceived. This seems also apparent from Dr Corrigan's experiment, in which he found that by "squeezing" two peritoneal surfaces covered with a layer of tolerably dense and spongy lymph, a creaking could be produced.[1] Different degrees of motion, however, may be necessary in the different modifications of the friction vibrations; and the less dense, and thick the layer of lymph, and the more elastic the subjacent organs, probably the greater will be the amount of motion required for their production.

From the *sixth column* in the table, it appears that almost every author who has made original observations on this subject, has recorded the peculiar *vibratory indications perceived by the sense of touch over the part affected;* and this, no doubt, has arisen from the necessity of manual examination of the abdomen leading so directly to their detection. The character of the sensations has been very differently described, even in the same case, at different periods of the inflammation; so much so, indeed, as to render it more than probable that the various physical conditions of the serous surfaces had given rise to corresponding modifications of this peculiar sen-

[1] Op. cit. p. 397. As has been remarked, there is little doubt that the honeycombed appearance of the recent lymph, so often seen in pericarditis, and which has also been observed on other serous surfaces, as the pleura, and peritoneum covering the liver, (Bright, Op. cit. p. 202), is the result of motion between these surfaces while the adhesions are soft and extensible. And so long as there is motion between the surfaces, there may be sound.

sation; and further observation may yet enable us to connect each species of friction vibration with a certain physical condition of the peritoneal surfaces. At all events, enough has been recorded to encourage us in pursuing this investigation, with the view, if possible, of rendering our diagnosis more minute than hitherto, that we may not only be enabled to detect the part affected, but the precise condition of the serous membrane, so that all remedial measures may be applied at the most favourable periods.

The sounds perceived either along with the tactile vibrations, or unaccompanied by them, and contained in the *seventh column*, are by no means so numerous as could have been wished for. Few as they are, however, they exhibit, as their identity of origin would have led us to expect, the same variations in character, as the tactile sensations, and so exact is the resemblance, and so much does the one indication suggest the other, that, in most instances, the same terms have been employed to describe them. It must not be supposed, that wherever a blank occurs in this column, no sound had been present in the corresponding cases; for any friction vibration perceptible to the touch, must have been distinctly perceptible to the ear, had the observation been made for the purpose of detecting it. On the other hand, a friction vibration sufficiently strong to give rise to audible friction phenomena, may not be perceptible to the sense of touch. And we have no hesitation in agreeing with Dr Corrigan, that, in cases where the friction vibration "*may be indistinct to the sense of touch, the stethoscope is of great use in detecting it*," . . . . . and that it "*may be heard loud to the ear while it is dull to the finger.*"[1] *From which we may draw the practical inference, that in an obscure case, the absence of all tactile vibration should present the strongest reason for minute auricular examination.*

From the terms used to describe the vibrations perceived by the touch, it appears, that these sensations varied in intensity from a *soft creeping, or gentle vibration, under the hand; or a sensation like that of the finger rubbed over a damp pane of glass;* to those of a more intense kind, described by the terms, "*creaking*," "*crepitus*," and "*grating*." The accompanying sounds varied in the same manner from a "*gentle rustling*," to a "*loud friction*," *and a sound of* "*creaking*." Judging from the descriptions, as contained in the table, the more intense friction vibrations, both of touch and hearing, must have possessed considerable analogy, although, no doubt, differing in intensity, as well as in character; but the observations on this point have been so limited, as to leave us very much in a state of mere conjecture as to how far the views of Drs Stokes,[2] Bouillaud,[3] Williams,[4] and others, in regard to the connection between the peculiar character and intensity of the friction

[1] Op. cit. p. 393, 394. [2] Dublin Journal of Medical and Chemical Science, v. iv. p. 56, 57, 1833. [3] Maladies du Cœur, v. i. p. 457, &c. Paris, 1835. [4] Path. and Diag. of Diseases of Chest, p. 236. London, 1840.

sounds, and the physical conditions of the serous membrane in pericarditis, may be applicable in peritonitis. They have hardly been proved in the former, and therefore we may suspend our judgment of them in regard to the latter. Unlike the cardiac apparatus in pericarditis, the abdominal organs differ very much in their physical characters, especially as to density and resistance; and therefore the same amount of inflammatory alteration of the serous surface over a solid organ, as the liver, the spleen, or an organic tumour, although sufficient to produce intense friction indications, might give rise, over the soft elastic stomach or intestines, to a greatly diminished degree of friction vibration. And should subsequent observation enable us to refer the different indications, described by the terms formerly noticed, to peculiar states of the serous membranes, our judgment ought always to be qualified by the consideration as to the solidity or non-solidity of the subjacent parts. Whether or not the specific peculiarities of the friction vibrations, apart from intensity, may yet be proved to depend upon the state of the serous surfaces, at different periods of the disease, at all events it will have been observed, that in those cases, in which the more harsh friction vibrations occurred, there existed a *rough, or more or less dense and rough, or rough and resisting condition of the parts.* In the *fourteenth* case, on the contrary, in which simple subacute peritonitis was present, the vibrations both by the touch and by hearing, were so soft and gentle, as, almost from this alone, to enable us to conclude that *no solid or otherwise indurated organ was at all concerned in their production, but that the intestines, distended with gas, as they were known to be, and probably only thinly covered with a very soft layer of lymph, alone gave rise to the indications under consideration.* But when we come to investigate the mechanism of the friction phenomena, this will be rendered sufficiently evident. The first report in the 9th case in the table, appears to corroborate these remarks; and, so far as it goes, this case possesses considerable interest, as presenting the only example on record, that I am aware of, in which the *progress of the inflammatory alterations are apparently pointed out by the friction vibrations, communicated to the sense of touch,* although wanting the evidence of post-mortem examination. The friction indications, in this instance, from having been at first very *soft and gentle,* became more *intense;* and, towards the termination of the case, somewhat *softer;* either as *adhesions formed, or as the roughness of the surfaces disappeared;* and had the patient lived, at last to disappear, as in the cases recorded by Dr Stokes.[1]

The immediate cause of the vibratory sensations, is the rubbing together of two peritoneal surfaces, physically altered in various ways; and in order to prove this by experiment, Dr Corrigan, by artificial

[1] Op. cit. M. Piorry has expressed it as his opinion, that when the peritoneum is covered with miliary granulations or other accidental productions, we are likely to hear special sounds. *Vide* p. 414, Traité de Diagnostic. Paris, 1837.

friction of one portion of peritoneum, which had suffered from inflammation, and was covered with lymph, upon another in the same condition, produced several of the indications described. It was easy, he informs us, to produce the "ordinary frottement," or friction sound, but he was only occasionally successful in producing the "new-leather creak;"[1] an observation of some interest, as pointing out how variations, probably in the mode of rubbing, or the degree of pressure exerted, may modify the character of the indications, and showing the necessity of farther inquiry.[2] That the peritoneal friction indications, however, may occur at a still earlier stage of the inflammatory process, before there is any effusion of lymph, and at a period when the serous surface is simply drier than usual, from a deficiency of its ordinary secretion, is a circumstance of great probability. M. Collin alludes to this state of the serous membrane as a cause of sound in pericarditis,[3] and Professor Andral admits "the suspension of the secretion of a part as one of the earliest effects of irritation, the secretion subsequently becoming either more abundant or modified in its character."[4] And if two comparatively dry peritoneal surfaces, as in the following experiment, be rubbed together, a friction sound is the result. A small portion of intestine was distended with air, and its serous surface dried by wiping off the serous moisture with a soft towel, which was also done to a portion of the serous surface of the abdominal parietes. The portion of intestine was then gently rubbed upon the latter, to which the stethoscope had been applied, when a distinct soft friction vibration was at once perceptible, very much like the "gentle rustling" which was perceived in the 14th case in the table. It was also observed that the drier the surfaces of the membrane, and the greater the degree of pressure exerted during the friction, the louder was the sound produced. Further evidence, however, is required before we can safely deduce any thing practically useful from these observations. But to this conclusion at least we may fairly come, that whatever be the state of the peritoneum, whether covered by lymph or not, the less moistened it is, and the greater the amount of motion of the one surface upon the other, the more intense will be the friction vibrations. On the other hand, diminution in the amount of the motion, and increase of lubrication of the surfaces by a liquid effusion, and the more oily in its character this is, the less intensely the friction indications will be perceived.[5]

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[1] Op. cit. p. 397. [2] Whether or not the indications described by the term "Crepitation," may at all result from the separation of lymph-covered, serous surfaces, on pressure or otherwise, subsequent observation may determine. Certain it is, that a sound of a crepitating kind occurs during the act of separation of parts, in a similar physical condition to the peritoneum so affected, and nearly free from serous effusion.

[3] De la Poitrine, p. 116. Paris, 1824. [4] Precis d'Anatomie Pathologique, p. 312. t. 1. Paris 1829.

[5] In the "Gazette des Hôpitaux," 14th December 1844, M. Marchal, in some observations, "de la *crépitation douloureuse des tendons*," which he denominates "*téno-*

So much for the immediate cause of the phenomena, but we have still to consider shortly the *peculiar mechanism by which such friction motion is produced;* and here it may be remarked that although we have to deal in this instance with a serous sac, analogous to the pleura and pericardium; still, in the case of the peritoneum, it is evident that there exist certain peculiarities, bearing upon the mechanism of the friction vibrations, of a more complex character than in either of the two cavities mentioned. In the pleuræ, for example, there is simply the motion of ascent and descent by which the surfaces are made to rub upon one another during respiration; and in the same manner the systole and diastole of the heart produce analogous motions of the two pericardial surfaces. In the case before us, however, there is not only the motion of the diaphragm and abdominal muscles during respiration,—restrained though it generally is—by which to a certain extent one portion of the peritoneum, especially at the upper part of the abdomen, is made to move upon another; but there likewise exists, probably at all times, except when paralysed by want of nervous energy, or by mechanical obstruction, *the peristaltic motion of the stomach and intestines*, by which it is evident that a movement of the one portion of the peritoneal surface upon another must be constantly taking place.

The mechanical cause of the friction indications is recorded in ten cases, as quoted in the *eighth column* of the table. In *six* it was the *motions of respiration*, that is to say, the *movements of the diaphragm and abdominal muscles;* and the vibrations were chiefly or most intensely developed during inspiration, and especially when this was deeply performed, so that the diaphragm was *manifestly* depressed; from which we are entitled to draw the practical deduction, *that the friction indications might by this act become developed, although absent during ordinary diaphragmatic movements.* In all these cases the inflamed peritoneum was connected with a solid resisting medium; and even in the fourteenth case, the vibrations, from the movements of respiration, occurred at the left false ribs, where this portion of the thorax not only presents similar physical conditions as to solidity, but where all motion, from depression of the diaphragm, must always be most evident. In *five* cases, *pressure with the hand on the abdominal parietes*, with or without the application of the ear or stethoscope at the same time, was the mode adopted

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synovite, (inflammation de la queue des tendons)" has the following remarks:—"En effet, la synoviale tendineuse n'est elle pas analogue à une séreuse, et le propre de l'inflammation d'une séreuse, n'est il pas, d'une part, de diminuer ou même d'arrêter l'exhalation dans les premiers moments, et d'autre part, de faire perdre à la membrane son poli? Etant données ces deux circonstances, la perte du poli et la sécheresse, rien de plus facile à comprendre que la crépitation. Le frottement pleural, le frottement péricardique, le frottement péritonéal, la crépitation propre à la poche synoviale prerotulienne inflammée et celle qui nous occupe, sont un seul et même phénomène,—à part le siége." For this notice, which was communicated to me since my paper was written, I am indebted to M. Piorry.

to elicit the friction vibrations. Of these a large abdominal tumour existed in *two*. In *one case alone* (No. 14) *were the phenomena perceived to arise spontaneously, and without being in the least indebted to the respiratory movements or to artificial pressure, but entirely resulting from the peristaltic motion of the intestines.*

All who have attempted to describe sounds and sensations of touch by words, have felt the difficulty of conveying an accurate idea of these perceptions. And this is an unquestionable barrier in the way of any attempt to prove—especially to those who may be altogether unacquainted with the character of the indications under consideration,—that the friction sensations perceived in the fourteenth case were purely the result of peristaltic motion. On this point I have not the smallest doubt; and to say that the peculiar character and rhythm of the friction vibrations as perceived in that case, afforded the most conceivably perfect representation that the senses of hearing and touch could receive, of the very remarkable vermicular motion belonging to the intestines, is to state nothing more than what seemed to be one of the simplest and safest acts of deduction from the facts observed. Without some acquaintance, however, with the peristaltic motion from observation in the lower animals, greater difficulty might have presented itself, and even this ought to have been diminished by the recollection of the descriptions given of the intestinal motions, which I have nowhere found so scientifically described as in the *Dictionnaire des Sciences Médicales*, by M. Piorry;[1] and the most concise and graphic account I have met with in the English language, is perhaps that of Dr Charleton, published in 1680, which is as follows:—"The manner of this subtle and complex motion may be conceiv'd from an inspection of the gutts of an animal newly kill'd, and opened while some reliques of the vital heat are yet remaining in them. For one shall see the gutts variously shortening, wrigling, and wresting themselves like a heap of earth worms, crawling some over others, and striving as it were to creep upward and downward by turns, but without a directing faculty."[2] Notwithstanding this impossibility of conveying by words all that was suggested to the mind on making the observations contained in the fourteenth case, still careful examination and analysis of the reports, which were made at the bed-side of the patient, I hope will enable those who are interested in this matter, to satisfy themselves, that the vibratory indications mentioned, could alone have been produced by the peristaltic motion of the intestines; and if this be not admitted, then no other apparent cause remains to which they can be attributed. My object in detailing all the circumstances, however trifling, connected with the peristaltic mechanism of the friction vibra-

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[1] Art. Peristaltique, Paris, 1819.

[2] Enquiries into Human Nature, &c., by Walter Charleton, M.D., p. 93, 4to, Lond. 1680.

tions, is to point out the probable improvement in our diagnosis from a knowledge of this cause of the friction phenomena, which sooner or later may be turned to account in practice.[1]

MM. Barth and Roger, probably following Dr Désprez, recognise the respiratory acts as the cause of the friction indications, but do not make mention either of artificial pressure, or of the peristaltic motion as causes of these. I will not, however, be so rash as assert that they are unknown to Dr Désprez, the results of whose observations these authors nevertheless seem to give; but I have not met with an account of any case similar to that which I have had the honour of communicating to the Society. (No. 14.) And the only author who notices the motions of the intestines as a cause of the friction vibrations, so far as my research has gone, is Dr Franz Zehetmayer of Vienna, who says, if the "surfaces of the serous membranes have lost their smoothness by lymphatic effusion, then a rubbing sound arises analogous to what is heard in the pleura or pericardium, only that in the abdomen is of course much weaker, in consequence of the *gentle motion of the intestines*, and the elastic or yielding nature of the parietes, which are not favourable to the origin of a more intense degree of friction."[2] Dr Zehetmayer's remarks appear to be nearly a condensed translation of the observations of Messrs Barth and Roger, who, as I have said, do not mention the peristaltic motion of the bowels as a cause of the friction vibrations; but whether or not the former author

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[1] That any peculiarity in the motion of the stomach, or great and small intestines, imparting a difference of character to the borborygmi, produced in these different parts, may, when the friction indications are present, enable us to detect the portion of the digestive canal affected, is perhaps not improbable.

The following continuation of M. Piorry's communication formerly quoted is interesting. He says,—"Du reste, je l'avoue, j'ai tiré fort peu de partie des bruits du péritoine recueillé par la stéthoscopie, dans la phlegmasie de la séreuse abdominale. Je crains même qu'on ait confondu avec les bruits certains frottemens que l'on entend lors des mouvemens inspirateurs, dans l'abdomen et qui sont les conséquences de l'abaissement du diaphragme qui pousse les visceres par en bas. Ces derniers résultats (les bruits dont il s'agit) s'entendent dans l'état normal; le murmure en question est très fin, très distinct des borborygmes, très différens aussi du bruit que fait entendre le tœnia, bruit que j'ai signalé dans mon quatrième volume de Médecine Pratique, (angibromopathies.) Dans ce dernier il n'y a pas d'isochronisme avec les mouvemens de respiration; il est constitué par une série de sons saccadés et véritablement vermiculaire. . . . Pour moi dans l'état actuel de la science, les principaux signes physiques dans l'affection précédente, (peritonitis) sont la matité plessimétrique des épanchemens; la circonscription et la détermination du lieu ou elle existe; le dégré de cette matité en rapport avec la profondeur de la couche du liquide; le déplacement de celui-ci dans diverses positions, &c. &c." I have never heard the normal "frottemens" mentioned by M. Piorry; and think it probable that the *bruit*, attributed to the tænia by this distinguished author, may have had peritoneal friction for its cause.

It may also be observed that it is important that the vibrations, sometimes perceptible to the touch, accompanying borborygmi, be not mistaken for the peritoneal friction vibrations. The former want the accompanying rubbing sound of the latter, and are attended by loud sounds, tolerably well described by the term *borborygmi* used to designate such sonorous indications, especially if the voice be raised as the word is pronounced.

[2] Grundzüge der Percussion und Auscultation, &c. p. 104. Wien 1843.

means this species of motion, or simply the passive motion of the intestines, consequent upon the movement of the diaphragm and abdominal muscles, his statement, which is very short, and without details, is insufficient to enable me to form a decided opinion.

Of the value of the facts connected with the friction vibrations, it may be remarked, in conclusion, that they appear to have placed within our power an additional method of detecting the existence of an important and frequently fatal disease, often obscure by the ordinary modes of investigation, whether from peculiarity of idiosyncrasy, or from the co-existence of cerebral complication, by which pain, and its characteristic results, with reference to the position of the patient, and to the respiratory movements, may have ceased to guide the physician in his diagnosis. In such cases the physical signs, known to be independent of any such influences, may be found to present perhaps the only safe indications by which to form our opinion as to the nature and extent of the disease.

The following are the chief conclusions which may be drawn from the previous observations :—

That the mechanism by which the friction vibrations are produced is of three kinds, viz.

1. The respiratory movements,—of the diaphragm chiefly,—but also the action of the abdominal muscles. The vibrations being synchronous with these movements, though sometimes only developed during inspiration.

2. Artificial movement of the parts by pressure with the hand or otherwise. The vibrations corresponding in their rhythm to the movement produced.

3. The peristaltic motion of the intestinal canal,—imparting to the vibrations a peculiar, continued rustling, and creeping character to the ear and hand, corresponding to the vermicular motion of the intestines.

That the immediate cause of the friction vibrations is the rubbing together of two peritoneal surfaces, physically altered by the inflammatory process ; and although the effusion of lymph has been considered necessary for their production, it appears highly probable that at a prior stage of the inflammation, when the peritoneum is merely drier than usual, friction vibrations may take place.

That the more the surfaces are moistened, the less intense will be the friction vibrations ; and when a liquid effusion is sufficient to separate the surfaces, the vibrations will cease altogether at the part ; but by altering the position of the patient, so as to enable the liquid to gravitate to some other part, and thus bring the surfaces together again, the friction vibrations will be renewed, as in Case 14.

That the amount of motion between the inflamed surfaces, necessary for the production of the friction vibration, is very limited ; and that different modes of friction, as to rapidity and degrees of

pressure, may not only modify the intensity, but also the tone and quality of the vibrations.

That the present state of our knowledge does not permit us to connect any particular species of vibration with a certain physical condition of the peritoneum, although reasonable grounds exist for this expectation.

That although the friction vibrations are no evidence of the existence of adhesions between the peritoneal surfaces, it has not been proved, that in the case of partial adhesions,—and even when the adhesions are general, provided the effused lymph be recent, soft, and extensible,—an amount of motion sufficient to produce the friction vibrations might not occur.

That the respiratory abdominal friction vibrations are chiefly manifested at the upper part of the abdominal cavity, where its more solid contents are situated, and in the case of a large organic tumour,—and may be regarded as indicative of the inflammation existing over a solid organ or tumour.

That the indications from artificial movement of the parts have been perceived, both where tumours were present, and where the intestines alone, or along with the omentum, were the site of the inflammation.

That the peristaltic friction vibrations indicate that the peritoneum investing the corresponding portion of the intestinal tube is the part affected.

That wherever the peristaltic vibrations are *very distinctly perceived*, they may be regarded as indicative of a lively and free motion of the folds of intestine upon one another, and upon the parietes; and of few or no adhesions existing between them. At all events, it shows that the intestines are not generally adherent, nor matted together into an adherent mass, nor, to any great extent, adherent to the abdominal parietes.

That in cases of peritoneal inflammation in the upper portions of the abdomen simulating pleuritis—as in Case 15—the presence of *any degree* of the peristaltic friction vibration might very much assist us in the diagnosis.