

Observations on the sensibility of the abdominal cavity / by K.G. Lennander, F.R.C.S.Eng., Professor of surgery in Upsala, Sweden ; Translated at the wish of the author and with the permission of the editor and publisher of the "Mitteilungen aus den Grenzgebieten der Medicin und Chirurgie" by Arthur E. Barker, F.R.C.S. Professor of surgery at University College, London.

Contributors

Lennander, Karl Gustav, 1857-1908

Publication/Creation

London : John Bale, Sons and Danielsson, Ltd., 1903.

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Lennander

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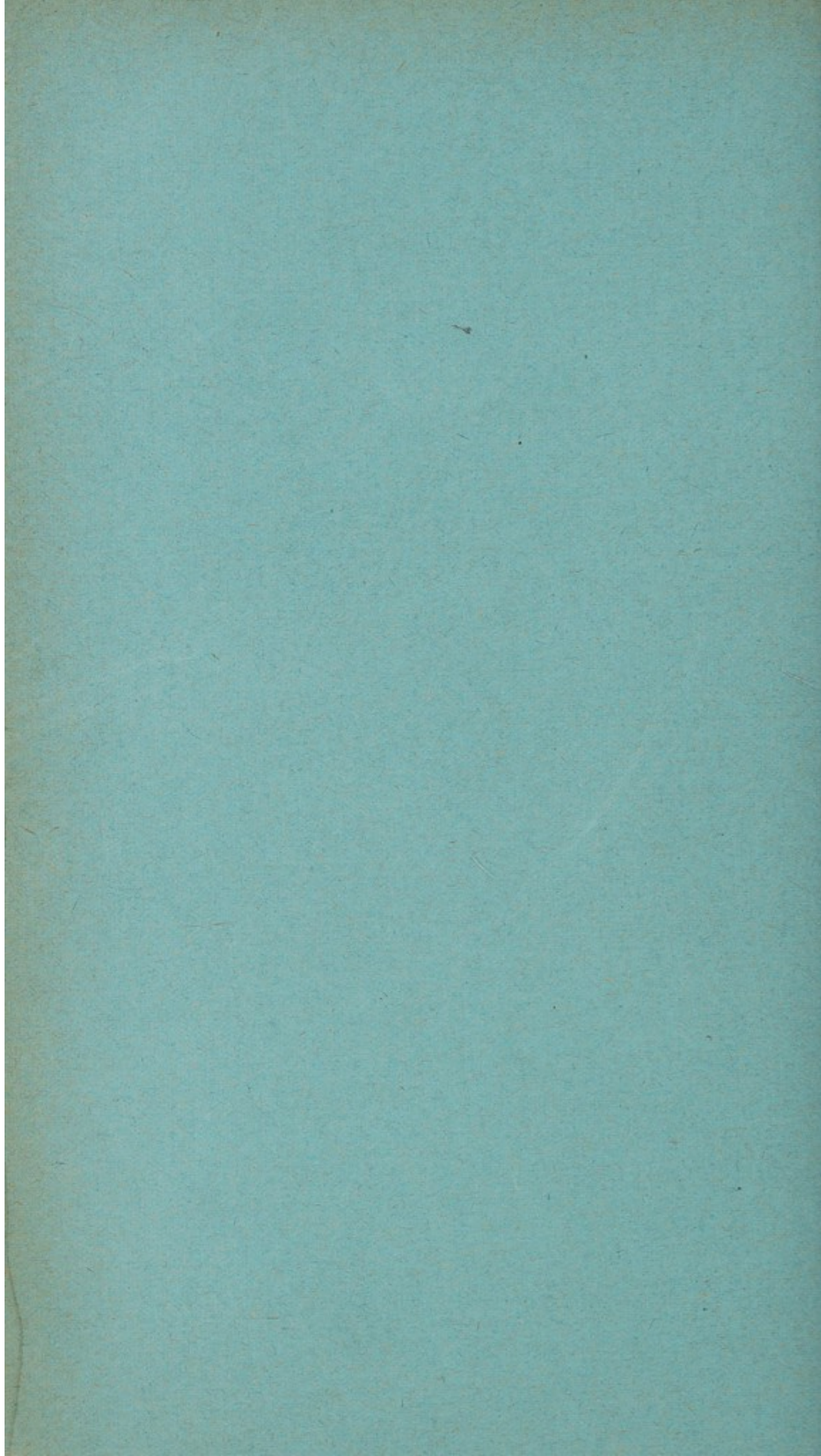
Sensibility of the

Abdomen

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of her child. The custom almost universal amongst the lower animals of eating the secundines is well known and the observation of the fact that it is followed by no ill results may well have led the primitive savage to employ the after-birth both as a food and a medicine. Various attempts have been made to explain this curious custom. It has been attributed to the promptings of hunger, to the desire on the part of the animal to hide all traces of its recent confinement so as to protect its newly born young from their enemies, or to the natural instinct that leads the mother to remove all traces of blood and dirt from her young and from her lair or nest. In administering the placental tissue as a

LEUCOCYTOSIS DURING DIGESTION.

It has long been admitted that during the process of digestion an increase takes place in the number of leucocytes to be found in the blood, but the period of digestion when this increase occurs, the extent and duration of the increase, and the characters of the leucocytes, as well as their source or sources, have not been satisfactorily ascertained. Nor has the effect of the presence or absence of the spleen been determined. The inquiry is a difficult one but it has been attacked by three physiologists working in concert and the results of their experiments have been published in a recent number of the *Journal of Physiology* (vol. xxx., No. 1). The enumeration of the leucocytes was undertaken by Dr. Alexander Goodall, the differential counts were made by Dr. G. Lovell Gulland, whilst to Dr. D. Noel Paton was intrusted the operative part of the proceedings, as the withdrawal of the blood, the removal of the spleen, and the determination of the hæmoglobin. Eight experiments were made, seven being upon dogs and one upon a cat. In each case the animal was kept fasting for a day; a little blood was then withdrawn and the number of leucocytes in a definite quantity was determined by means of the Thoma-Zeiss leucocytometer, whilst simultaneously the amount of hæmoglobin was determined with Oliver's hæmoglobinometer in order that any error arising from differences in concentration of the blood might be excluded. The animal was then fed on as much minced beef and water as it would eat. The experiments showed that there was a tolerably regular rise in the total numbers of leucocytes in the circulation and that this increase reached its maximum about four hours after the ingestion of food. The increase is due partly to a lymphocytosis which is very constant as regards its incidence and degree and partly, in the greater number of cases, to a much more variable polymorphonuclear leucocytosis. Leucocytosis during digestion is not affected by removal of the spleen. The organs to which these experimenters attribute the increased numbers of the leucocytes during and after digestion will constitute the subject of another communication.

SOME interesting observations on the sensibility of the viscera have been made by Dr. K. G. Lennander and are recorded in the *Mittheilungen aus dem Grenzgebieten der Medicin und Chirurgie*, Band x., 1902, Hefte 1 und 2. As a result of an investigation of various viscera during the course of cases of operation he states that the parietal peritoneum is very sensitive to all operative measures but that the intestinal canal, the mesentery, the stomach, the anterior margin of the liver, the gall-bladder, the urinary bladder, and the parenchyma of the kidney are completely insensitive to all manipulative procedures and even to the

thermo-cautery. The parietal peritoneum itself appears to be sensitive only to painful and not to tactile or thermal stimuli; this sensibility to pain Dr. Lennander attributes to twigs of the intercostal nerves in the subserous areolar tissue. The lungs and the anterior wall of the trachea are also insensitive. The mucous membrane of the rectum is likewise insensitive to all ordinary stimuli but if its lumen be distended to a diameter of three and a half to four centimetres a desire to defecate is produced. Again, the testes and epididymis are insensitive while their coverings are sensitive. Dr. Lennander infers that organs which are innervated from visceral nerves alone are insensitive, while those having branches supplied to them from somatic nerves are sensitive. There is perhaps little that is new in these observations of Dr. Lennander or in his interpretation of them but they lend strong support to the view that at any rate some sensations of pain depend upon nerve fibres anatomically distinct from those subserving tactile and other cutaneous sensations, since the parietal peritoneum is apparently sensitive to painful stimuli only. At the same time that diseased or injured viscera may give rise to painful sensations interpreted locally—that is to say, apart from, or in addition to, referred pain and tenderness—is a matter of daily observation and this variety of pain is usually regarded as due to an exaggeration or augmentation of the common sensibility of the part, of which in health there is no conscious appreciation.

DETERMINATION OF FAT AND TOTAL SOLIDS IN MILK.

IN the August number of the *Archives of Paediatrics* Dr. Henry L. K. Shaw of Albany, New York, gives details and results of a number of comparative experiments made with different processes for the determination of the fat and the total solids in milk. He first describes the Babcock method of determining fat, a method which, he says, is distinctively American and is widely employed by American dairymen. It requires a centrifuge and at his suggestion a small one has been manufactured for the use of medical men. The process is as follows: 17.5 cubic centimetres of milk are first measured into the test bottle and 17.5 cubic centimetres of sulphuric acid of specific gravity 1.082 are then slowly added. The milk and acid are thoroughly mixed by a rotary motion, placed in the centrifuge, and whirled for four minutes. Boiling water is then added by means of a pipette until the lower part of the column of fat comes within the graduated scale on the neck of the bottle. A second whirling for one

Lancet Dec-24-1903

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of the Editor and Publisher of the "Mitteilungen aus den
Grenzgebieten der Medicin und Chirurgie"

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London

JOHN BALE, SONS AND DANIELSSON, LTD.

OXFORD HOUSE

83-89, GREAT TITCHFIELD STREET, OXFORD STREET, W.

1903



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TRANSLATOR'S PREFACE.

No one who reads the following essay carefully can fail to be impressed by the conclusions which it suggests. It does not aim at being a plea for local anæsthesia. Incidentally the propriety of the employment of this procedure in many important operations is discussed, and, I think, frankly and temperately. It is in its bearing upon physiological problems and clinical diagnosis and treatment that the chief interest of Prof. Lennander's observations lies. And if further investigation shows them to be sound we may look for much new light upon a long series of obscure conditions for whose diagnosis we have always been dependent largely upon the appreciation of subjective phenomena, the interpretation of which has been very difficult. In no class of cases, for instance, ought the fuller knowledge of the real seat and nature of pain and tenderness to be of more importance than in the large group of conditions dependent upon inflammations in the vermiform appendix. The daily study of these, and of those diseases so easily confounded with them, must convince every physician and surgeon of experience more and more of their complexity, and all must welcome every observation bearing upon their physiology, pathology, and differential diagnosis.

Having last summer been favoured by my old friend, the author of this paper, with one of the first "reprints" at his disposal, I read it with the keenest interest. It appeared to be not only intrinsically, but also from its suggestiveness, of such value, both for physicians and surgeons, that I determined in spare moments to

Preface

write it into English at the second or third reading, for the benefit of my house surgeons and hospital pupils. Having suggested to the author that his paper ought to be printed in English for the benefit of a larger circle of readers, he very warmly took up the idea, and wished this translation to appear in the slightly abridged form to which it has been reduced.

My own special interest in the subject is based upon the fact that I have since 1898 been employing infiltration analgesia in many scores of operations, great and small; and from what I have seen in these I can only say that I believe that the views the author puts forward on the sensibility of the abdomen are well supported by facts so far, and that they will exercise a most important influence upon the clinical study of abdominal and other affections when their range of applicability has been fully appreciated.

January 1, 1903.

A. E. B.

OBSERVATIONS ON THE SENSIBILITY OF THE ABDOMINAL CAVITY.

BY PROF. K. G. LENNANDER, F.R.C.S.ENG.,
of Upsala, Sweden.

INTRODUCTION.

IN the autumn of 1900 I had the opportunity of making some observations on the sensibility of the abdominal cavity during sundry operations on abdominal organs and herniæ under local anæsthesia alone, or combined with general anæsthesia. The sum of the conclusions arrived at may be thus briefly stated. The parietal peritoneum is extremely sensitive to all operative manipulation. The intestinal tract on the other hand, the mesenteries, the stomach, the anterior border of the liver, and the gall bladder, the great omentum, the serous covering of the bladder, as well as the parenchyma of the kidneys, are wholly insensitive to operation even with the thermo-cautery. These organs are insensible to pain or touch. I have mentioned here the organs or parts of organs which I have actually investigated, but it will be noticed that I have no experience in this direction in reference to the duodenum. In regard to several of the organs named above, I have investigated their sensibility to temperature, and have found that contact with warm or cold metals or with ice is not felt, not even as a touch. In regard to the parietal peritoneum, I have not been successful in obtaining evidence as to its special sensitiveness to touch, heat, or cold. But on grounds to be

referred to presently (Case 24 and "Remarks" on Case 23) I am led to the conclusion that the parietal peritoneum is only sensitive to pain.

In a note published in the *Centralblatt f. Chirurgie* * I gave a brief abstract of the results of my investigations, and pointed out their bearing on diagnosis, and especially on the diagnosis of peritonitis. At the same time I endeavoured to furnish an explanation for many of the pains felt in the abdomen. I now wish to place the reports of many of the operations from which these conclusions were drawn before my readers.

Having had abundant experience of the injurious effects—I might almost say the exhausting effects—of severe pain on a weak heart, I had always had great fear of laparotomy performed under local anæsthesia. In the autumn, however, I felt myself compelled to undertake such an operation. I therefore requested my assistants, Ivar Segelberg, P. Haglund, and Gunnar Nyström, to help me in making careful observations on the conditions of sensibility in the abdominal wall and in the abdominal cavity. We arranged that Nyström should devote himself exclusively to the observation of the patient—that is to say, that he should talk with him, ask him questions as to whether he was suffering pain and above all that he should study the expression of his face and gestures. He was to report in shorthand every operative detail carried out by me and any consequent effect on the patient. This division of labour has been followed throughout. In this way Nyström has noted every cut, every compression with an artery forceps, every strain upon particular tissues, &c., &c., which I have made in a large series of operations. These very detailed reports we have gone over together immediately after the operation, and compared them with the notes of the procedures themselves, which I am about to publish. To indicate the degrees of pain we have employed the terms "slight pain," "pain," and "severe pain," meaning by the first

* No. 8, 1901; also *Upsala läkarefören. förh.*, Bd. vi., Heft 5 and 6.

a condition in which the patient himself hardly knew that he felt it, or declared that it was absolutely insignificant. Whenever "severe pain" was felt we have always put it to the patient to determine whether he would have general anæsthesia or not. The greater number of these operations were performed before the usual class of senior students.

Surgical procedure and antiseptics have at the present time attained to such a stage of safety that in many cases the narcosis may be regarded as relatively the most dangerous factor in an operation. The efforts, therefore, now being made to replace general anæsthesia by local are not only justified but belong to the most important questions in surgery. At the last Congress of Surgeons in Berlin (April, 1901) this was the most burning question considered. The discussion as is well known was introduced by v. Mikulicz and Bier. But in order to correctly employ either general or local anæsthesia it is indispensable to know *what produces pain* in each case. The object of the following observations has been to gain evidence upon this point. It is quite clear that if our operative manipulations evoke no sensation of pain in certain organs a knowledge of the fact must have an influence upon our methods of producing anæsthesia.

The basis of my present conceptions in regard to the sensibility of the abdominal cavity is not only the experience gained in the operations recorded here, but also in a considerable number since undertaken. This paper was written during my last Christmas holidays, 1900-1901, and further elaborated during the winter, although I had no opportunity of finally correcting it until August, 1901. Further additions were made during the revision of the "proofs"—March, 1902.

Among the patients whose cases are here to be recorded many have distinctly wished to be spared the unpleasant effects of general anæsthesia. In a few other cases the condition of the patients was so bad that I could not accept the risks of an operation under general anæsthesia.

In most of the cases I considered it best on account of the presence of cardiac troubles, or disabilities in the vascular system, in the lungs, or in the kidneys, to operate under local anæsthesia or of a combination of the latter with the general, and have told the patients so. It was only when I had before me such operations as radical cures of hernia in otherwise perfectly healthy individuals, that I worked with local anæsthesia as a matter of observation. I was of opinion that our object in such operations ought to be to make them absolutely innocuous and that cannot be done as long as we employ general narcosis. Gangrenous herniæ are now always operated on under local anæsthesia in the Klinik in Upsala. Previously for the last ten years it had always been the custom to stop the general anæsthetic as soon as the resection of the bowel began and only to return to it so soon as the patient showed signs of suffering pain. We had long been of opinion that the gut was but slightly sensitive to operative manipulations, and, further, that the general anæsthesia was the most dangerous factor in these procedures.

During operations under local anæsthesia the patients ought neither to see the instruments or the surgeon, at least not his hands, and they ought to hear as little of what is said as possible. To this end we are in the habit of placing a screen over the neck of the patient and of placing plugs of cotton wool dipped in molten paraffin in his ears. The patients must lie comfortably on a warm table and as far as possible be allowed to change their position when they feel fatigue. Someone must devote himself to cheer them up, to offer them fluids in the form of water or stimulants; in short, to play the part of what the Americans call "the moral anæsthetist."

We have been in the habit of giving subcutaneously from $\frac{3}{4}$ to 1 cg. of morphia half an hour before the operation, and in many cases I have given a second similar dose during the latter. Beside this all these patients have had 1 mg. of strychnine nit. (0.01 : 10 aq. dest.) and 2 gr.

camphor oil (1 : 4) as a stimulant half to three-quarters of an hour before operation. I have for the last six years been in the habit of employing this preventive stimulation of the heart in all weak patients as well as in those for whom I foresaw that the operation would be of long duration. Injections of camphor *during* the operation on the other hand have been extremely rare.

In the following remarks I shall pursue the same course which I have followed in the investigations upon which they are based. In the first place some of the cases will be recorded which aroused my own interest in the subject, and a brief review of the literature of the latter will follow in about the same order in which it became familiar to myself. I shall then report my own further observations, which will naturally gain in value as I become acquainted with the experiences of others. In conclusion I shall add a few words as to the bearing of this question upon the whole subject of anæsthesia.

The operation which first aroused my interest in observations upon the sensibility of the abdominal cavity was briefly as follows:—

CASE 1.—On September 26th, 1900, I performed a cholecysto-jejunostomy on a man of 44, from Arjeplog, Lappland. For many years he had had violent attacks of pain in the belly, and for ten years and more icterus. For more than five years his motions had been slate-coloured. I found no gall stone and no tumour, but a whole chain of swollen hard lymph glands from the pancreas up to the *porta hepatis*. The gall bladder was of normal size and surrounded with firm adhesions and full of normal bile. The liver was somewhat enlarged, and felt harder than usual. In spite of distinct doubts I thought it necessary to make an anastomosis between the jejunum and the gall bladder. In doing this I drew a loop of the jejunum through the mesocolon. The course of the case was without fever, but two days later it became clear that in the anastomosis there was some cause of obstruction. The patient suffered from vomiting, for which

the stomach had to be washed out. In spite of this on September 28th a large quantity of greenish stinking fluid was removed by the stomach tube. It appeared to me clear that a second anastomosis ought to be made between the afferent and efferent limbs of the loop anastomosed to the gall bladder; but it seemed equally clear that the patient would not bear general narcosis.

The following is an abstract of the case:—

There was thin sanious fluid in the abdomen. The afferent limb of the bowel going to the gall bladder was much distended, having a diameter of 7 to 8 cm. The wall of this part of the bowel appeared swollen, and the serosa was much injected. The efferent limb was of normal appearance. An anastomosis was now made between the two limbs, the opening being about 5 cm. But before this was possible several hundred cubic centimetres of greenish stinking fluid had to be drawn off from the afferent loop.

The report of the amanuensis, Nyström, in regard to "pain" runs as follows:—

Before the operation 0·6 cgr. morphia subcutaneously. Anæsthesia by Schleich's infiltration method, about 200 ccm. of solution No. 2. diluted four times being used, *i.e.*, 0·05 gr. cocaine + 0·01 gr. morphia + 200 ccm. salt solution of 0·81 per cent.

OPERATION.

Lateral köliotomy through the sheath of			
the left rectus muscle .. .. .	..	..	Pain.
Skin incision .. .. .	..	..	No pain.
Hæmostatic forceps on vessels in skin ..	..	..	Pain.
Subcutaneous fat .. .. .	..	..	No pain.
Ligature of vessels in skin .. .. .	..	..	Pain.
Division of anterior aponeurosis of rectus ..	..	..	Pain.
Loosening the border of rectus, and pulling			
it towards the middle line .. .. .	..	..	Severe pain.
Forceps on a vessel and nerve .. .. .	..	..	Severe pain.
Ligature of the same, distally .. .. .	..	..	Severe pain.

Ligature of stump of same, mesially ..	No pain.
Division of posterior rectus sheath (scissors)	Pain.
Stretching of abdominal wound ..	Severe pain.
Pulling out the intestines ..	Severe pain.
Replacing the intestines ..	Severe pain.
(Replacing the bowel seemed to be more painful than drawing it out).	
Stretching of the bowel—jejunum— $\frac{1}{3}$ to $\frac{2}{3}$ metre from duodenum, but without pulling on the mesentery (for instance, pressing out the contents between the fingers before grasping with Doyen's forceps):	
(a) Healthy loop of bowel ..	No pain.
(b) Markedly hyperæmic and distended loop ..	No pain.
Wiping the serosa of gut with dry gauze:	
(a) Healthy loop ..	No pain.
(b) Hyperæmic loop ..	No pain.
Puncture of distended injected bowel ..	No pain.
Incision of intestine in all its coats, healthy or injected ..	No pain.
Withdrawal of a gauze swab which was rather tightly held by intestine and mesentery ..	No pain.
Withdrawal of other swabs from the abdomen ..	Pain.
Reposition of anastomosed bowel in abdomen ..	Severe pain.
Placing a swab on replaced bowel ..	Pain.
Suture of skin, median side of wound, one hour after local anæsthesia ..	Pain.
Suture of skin, outer side ..	Pain.
Removal of hæmostatic forceps ..	No pain.
Ligature of pinched tissues ..	No pain.

The wound was for the most part left open The functions of the intestine returned at once.

My general impression from this operation was this :— The operation was painful in the whole abdominal wall, with the exception of the skin and the subcutaneous areolar tissue, which were properly infiltrated. Stretching of the wound with large blunt hooks caused severe pain. Pain was specially marked during the lifting out and reposition, above all of the bowel, the packing of gauze within the abdomen, and its withdrawal. Nevertheless, a swab could be removed painlessly which was not in contact with the parietal peritoneum. The patient had no sensation for manipulations of the intestines themselves so long as the mesentery was not pulled forwards. This stretching forwards of the mesentery of the affected bowel appeared to be specially painful (*conf.* Case 3). The unhealthy intestine appeared to be as insensible as the sound.

PARIETAL PERITONEUM AND GREAT OMENTUM.

During the autumn I performed a series of operations for inguinal herniæ under local anæsthesia, following Harvey Cushing,* who in happiest way combined Schleich's infiltration method with Oberst's injection of cocaine into the nerves. Here the skin and subcutaneous tissue is first infiltrated after Schleich; then the nerves of the inguinal region are sought for, *i.e.*, the ilio-hypogastric and inguinal, perhaps also the median branch of the genito-crural. These vary naturally in course and distribution. Into each of these Cushing injects 1 gr. of a 1 per cent. solution of cocaine. Personally I have only employed a $\frac{1}{2}$ per cent. solution, not stronger. If the right nerves have been struck the patients, according to Cushing, have no sensation in the m. m. obliqui and transversalis, in the hernial sac, in the spermatic cord and testicle, so far as its coverings are concerned. But the point at which the testicle is attached to the floor of the

* "The Employment of Local Anæsthesia in the Radical Cure of Certain Cases of Hernia, with a Note upon the Nervous Anatomy of the Inguinal Region." *Annals of Surgery*, January, 1900.

scrotum is an exception, being innervated from the pudendal nerve. I must confess that I have never achieved so complete an anæsthesia. Even in my best results from this method, where the nerves have been found and injected with cocaine, the upper part of the sac and the cord, *i.e.*, the parts closest to the ring, have never been exempt from pain, and if the injection into the nerves had been less successful, another part of the cord and the sac was still sensitive. During the last few weeks we have often employed anæsthile * instead of Schleich's method on the subcutaneous structures after the first incision.

In such operations one has a good opportunity of observing the sensibility of the parietal peritoneum, the omentum, and intestines. Notes of some of these operations will now be given, and first a case of a large inflamed omental hernia of the scrotum on the left side, with slight symptoms of incarceration. The patient was an overworked artisan of 34 years. The temperature was 38° C. The following notes were dictated :—

CASE 2.—No. 646 B., 1900, November 9th. Before the operation 0·75 cgr. of morphia subcutaneously. Schleich's infiltration into the skin. Into each of the nerves taken to be the ilio-hypogastric and inguinal 2 grm. of a $\frac{1}{2}$ per cent. solution of cocaine were injected. The sac was opened, and one saw that a large mass of omentum reached down into the scrotum. As the incision in the skin and sac was prolonged towards the root of the penis and the scrotum drawn forwards the omentum could be pulled out of the latter. About 100 cc. of yellow fluid now flowed out of the sac. The omentum consisted in part of a large lobe showing much fibrous change due to prolonged pressure, and in part of thin unaltered tissue proper to the healthy structure. As it was quite impossible to tell whether there was underlying intestine, the omentum was very cautiously divided, leaving about one-third of it behind. It was then easy to see that there

* A mixture of æthylchloride and methylchloride.

was no included bowel, and that a better pedicle could be obtained by removing the rest of the omentum. This was done after ligature with No. 4 catgut in grooves made by crushing the omentum with strong forceps. During the closing of the forceps on the omentum and application of the ligatures the patient declared that he felt not the least pain. After this the separation of the sac was undertaken, which was difficult, partly on account of adhesion to the cord, &c., and partly because there was no insensibility in the sac near the rings. As soon as the sac was pulled upon pain was complained of, apparently owing to stretching of the parietal peritoneum. I was content, therefore, to separate the sac close to the rings and close the abdomen with a row of catgut sutures. Bassini's operation followed. An opening for drainage was made in the lower part of the scrotum, in which a coarse tube was inserted.

November 19th.—The patient states that during the operation the most unpleasant sensation was a rapidly transient pricking or burning pain which he localised in the middle line, and which he thought came from the bladder. With this sensation, which recurred over and over again, he felt a desire to make water, although he had already emptied his bladder just before the operation. Next to this what gave him most pain was the stitching of the skin. On the whole, however, his suffering was easy to bear. He felt hardly any pain after the operation so long as he remained motionless. (Notes by the special observer, a student, G. Göthlin.)

The record runs thus:—

Skin incision	..	..	..	..	No pain.
Subcutaneous fat	..	..	..	..	No pain.
Hæmostatic forceps	..	..	..	..	Slight pain.
Injection of $\frac{1}{2}$ per cent. solution of cocaine					
into the inguinal nerves	..	..	..	..	Slight pain.
Stretching of the sac	..	..	..	..	Severe pain.

In the operation the sac was divided transversely, the lower half being left in the scrotum. As long as this

portion remained connected with the parietal peritoneum all manipulation of it produced pain, *i.e.*, when it was dragged upon, or pinched with forceps, or cut.* As soon as it had been divided it became absolutely insensitive. It is therefore clear that the pain in the distal portion of the sac depended upon the presence of nerves special to the hernial sac, and probably reaching it in the rings. In the proximal part of the sac pain could always be provoked, not only at the seat of operation, but also and to a greater extent in the interior of the abdomen.

A large part of the omentum was resected.

Drawing down of the omentum	..	..	Severe pain.
Pinching it with forceps	..	..	No pain.
Dividing it	..	..	No pain.
Ligature of it..	..	..	No pain.
Stretching of the spermatic cord	..	..	Severe pain.

There was no trace of pain in any part of the treatment of the omentum, nor was the sense of touch present.

CONCLUSIONS.

The parietal peritoneum is obviously very sensitive, particularly to dragging. Normal and altered omentum on the other hand is absolutely without sensation to all impressions. But dragging the omentum out of the abdomen is very painful. It was, however, impossible in this case to determine whether this was due to strain or friction on the parietal peritoneum, of the inguinal canal and neck of sac, or to drag on the transverse mesocolon or phreno-colic ligament, or more probably on both. The patient could not localise the pain.

The recovery in this case was normal, except for a hæmatoma in the scrotum.

The next case was one of reducible hernia on the right side, on which a Bassini's operation was performed on December 1st.

* This is only sometimes the case. In many instances it is quite insensitive. (Translator.)

CASE 3.—No. 338 A., 1900; 0.75 cgr. morphia before the operation, which was done under local anæsthesia by Cushing's method, *vide sup.*

Skin	No pain.
Subcutaneous fat	No pain.
Aponeurosis of oblique muscle	No pain.
Separation of aponeurosis from the underlying muscles with an elevator and from the other structures of the abdominal wall.. .. .	Slight pain.
Injection of inguinal nerves with 1 per cocaine	No pain.
Division of the areolar tissue at the inner side of the ring	No pain.
Exposure of the front part of the sac, and opening of the same	No pain.
Introduction of the finger into the abdomen	Slight pain.
Isolation of sac with a strong pull	Pain.
Hæmostatic forceps on the proximal part of the sac	Pain.
Incision at the same point	Pain.
(The pain was greater the nearer one came to the drawn down parietal peritoneum.)	
Ligature of the neck of the sac	Severe pain.
Isolation of the cord posteriorly	Pain.
Suture of internal muscles to Poupart	No pain.
Knotting of the sutures loosely	No pain.

It is uncertain in this case whether the inguinal nerves were cocainised. The whole distal part of the sac and the anterior side of the cord were completely insensitive. but the proximal portion and the posterior part of the cord appeared to possess normal sensation. The patient's own account of his condition is given on the evening of the day of operation by O. Janson. "During the operation it burned and cut" in the field of operation "four or five times, but not violently"; further than this the patient felt "absolutely nothing." There was no nausea or other

unpleasant effect during the operation. Immediately after the latter the patient was given some meat and custard without nausea. Temperature 37.4° in the rectum. Healing by first intention.

The patient in Case 2 believed the pain to originate in the bladder, and others have referred it to the urethra, as in the next Case 4.

After reading over Case 4, one of my friends, a medical man seventy-two years old, who had a left, probably direct inguinal hernia made the following statement to me:—
“On two occasions when my rupture had come down owing to my standing up without my truss I felt rather severe pain partly in the interior of the belly, but particularly in the region of the spleen and kidney and partly in the penis or more correctly at the orifice of the urethra. On each occasion the pain immediately disappeared on lying down and easily reducing the hernia. And now whenever I feel a sudden pain in the left lumbar region I always look to my truss and readjust it, to my relief in most cases.”

Prof. E. Clason informs me that it is believed that the urethral mucous membrane is innervated by the pudendal nerve and that it must, as a derivative of the external skin, also possess cutaneous nerves.

Before we go further it will be desirable to see what others, some surgeons, some pure physiologists, say about the sensibility of the abdominal cavity.

LITERATURE.

Schleich* considers the parietal peritoneum to be very sensitive. He describes in the most detailed manner how the parietal peritoneum has to be infiltrated in exactly the same way as the skin before it is cut. Then if the operation on the abdomen is to last longer than twenty minutes he advises a fresh infiltration of the serous edges before suture. He also expresses the opinion that the ovaries and ovarian tumours, the tubes, the uterus, the gall-

* “Painless Operations,” third edition, pp. 233-238.

bladder, the stomach, the sigmoid flexure are possessed of sensation, and he describes the way of infiltrating their walls. The remaining portions of the intestinal tract he does not mention.

In the various articles on abdominal surgery in the large "Handbuch der praktischen Chirurgie" of v. Bergmann, v. Bruns, and v. Mikulicz, the first edition of which is just completed, I only find one remark upon the sensibility of the abdominal cavity. This is to be found in Körte's essay* and runs thus: "While the healthy serosa is hardly sensitive, as may be seen where local anæsthesia is employed, any handling of the inflamed peritoneum is excessively painful and it is also the seat of spontaneous pain." Körte does not allude to any difference in this respect between the parietal and visceral portions.

Harvey Cushing† describes a case of a 2 mm. perforation of the intestine owing to a typhoid ulcer. The abdomen was opened under Schleich's infiltration. The ruptured Peyer's patch and two others nearly ruptured were folded in and overstitched. "The patient made absolutely no complaint of pain during the procedure." In this case at all events it was shown that the diseased bowel was insensitive to operation.

So far as I know, there are nowhere to be found so many interesting personal observations on the conditions of sensibility of the body as in Bloch's work on the sensation of various tissues.‡ I will now quote the most important of his remarks upon the point in question, p. 33: "The visceral as well as the parietal peritoneum possess no feeling. The former on healthy intestine may be cut through without the patient feeling anything, not even a touch." On pp. 33-35 he describes the excision of a prolapse of the bowel, which involved the upper part

* Reprint of his "Essay on the Peritoneum," p. 17.

† "Exploratory Laparotomy under Local Anæsthesia for Acute Abdominal Symptoms occurring in the Course of Typhoid Fever," *Philadelphia Med. Journ.*, March 3rd, 1900.

‡ Oscar Bloch, "Om Inskränkning i användningen af Inhalationsanæstesi, &c.," *Nord. med. Ark.* 1899, No. 33.

of the rectum and lower part of the sigmoid flexure. Here, without any anæsthesia at all, he observed that no pain was suffered. On p. 35, on the other hand, he says: "Diseased peritoneum, especially when acutely inflamed, is very sensitive. One has only to remember peritonitis and ordinary pain in the belly." "But the peritoneum of the intestines, in which there is venous stasis or a granulating surface, &c., is insensitive." "I must repeat that whoever will observe the conditions of sensibility of the peritoneum must avoid any dragging on it, for this produces pain." P. 36: "The omentum is without feeling when healthy." A patient whose mesentery was perforated and transfixed with a glass rod for colotomy without chloroform complained of no pain. P. 40: "From my own observations it is clear to me that the mucous membrane of the intestine may be touched or cut with knife or scissors, and the patient may feel no pain." Bloch, therefore, makes no distinction between the visceral and parietal peritoneum or the whole intestinal wall in respect of sensibility. According to him, these parts when healthy are as good as insensitive, but under morbid conditions such as "peritonitis or general abdominal pain," are extremely so. Byrom Robinson* expresses the same view in regard to the sensibility of the peritoneum after many years of study of the healthy and diseased abdominal cavity. This is also the view which has had the support of physiologists ever since the researches of Flourens. In his article on "Pain," Richet says: "Cette difference de sensibilité entre des parties enflammées et des parties saines est telle que certaines organes absolument insensibles normalement, deviennent sensibles aux excitations douloureuses quant ils s'enflamment." Thus it is, according to him, with the sensibility of certain "organes viscéraux dont la sensibilité normale est pour le moins très obtuse. L'estomac, les intestins, la vesicule biliaire, le vessie sont dans ce cas." †

* "The Peritoneum," Chicago, 1899.

† C. Richet's "Dictionnaire de Physiologie," Prem. fasc. du Tome v., Paris, 1900, p. 186.

Bloch says the same in a somewhat older work, "Bibliotek for Läger, 1898," which was only accessible to me some months after my quotation above had been written. It is especially interesting that in this work Bloch refers to the views of older authorities as they are given by Monfalcon and * Piorry † at the beginning of the last century. According to the latter, Bloch mentions that Bichat "has seen dogs devouring their own intestines and tearing their own peritoneum when these had prolapsed through abdominal incision." He says further of the serous lining of the abdomen: "I have often observed with the greatest wonder the lack of feeling in the parietal peritoneum during ovariectomies and myomectomies, and, indeed, so often that I do not think there can be any mistake about it. I have, to be sure, seen a surgeon arrive at an opposite conclusion during an operation, but I believe he had exerted traction on the peritoneum before he incised it." "The diseased peritoneum," says Bloch, ‡ without drawing any distinction between the parietal and visceral serosa, "is, on the contrary, as is well known, extraordinarily sensitive, at least in the condition of acute inflammation." To obtain clear information on these points I turned to my friend Prof. H. Öhrvall of Upsala, whose important works on the physiology of the senses are known everywhere. He has informed me that in the newest text-books of physiology nothing is mentioned in regard to the sensation of the peritoneum, as there has been no opportunity of observation since ether and chloroform have come into use. One would have to go back to the time of Weber and Haller for allusions to these points. Prof. Öhrvall was kind enough to help me to find the following in these two classical authors:—

E. H. Weber § mentions that he had an opportunity

* *Diet d. Sciences Med.*, T. xxxvii., p. 403, Paris, 1813.

† *Ibid.*, T. li., "Sensibilité," Paris, 1821.

‡ *Vide sup.*, p. 105, Bloch.

§ E. H. Weber, "Der Tastsinn und das Gemeingefühl," p. 514 *et seq.*, in R. Wagner's "Wörterb. d. Physiol.," Bd. iii., § 2, Braunschweig, 1846.

when with Prof. G. B. Günther of observing the insensibility of the intestines to *cold*. Several loops of bowel had escaped through an abdominal wound, "only covered by the prolapsed peritoneum"—from the context the omentum is obviously meant. These loops were covered with cloths dipped in cold water, but the patient had not the least feeling of cold, pain, or pressure. Steinhäuser came to precisely the same conclusions as Weber after observations on prolapsed mucous membrane of the large intestine in a case of artificial anus in an otherwise healthy woman. When the mucosa was alternately touched with ice and a metal instrument so hot that it could not be grasped by the hand the patient noticed nothing; and if a needle was thrust through it, or it was rubbed with caustic, or a piece was cut from it with the scissors, she had not even the sensation that it was being touched. These experiments were repeated many times with the same result.

Weber continues: "When one swallows very warm or cold fluids one notices that the tongue, palate, and pharynx, possess tactile sensibility. But from this point onward the latter disappears, or at all events becomes so imperfect that one doubts whether it is present at all or not. If the stomach or rectum be filled with warm or cold fluid the surrounding membranes and muscles ought to suffer a reduction of temperature, and consequently to feel the impressions of heat or cold within a few seconds. But here nothing is felt at temperatures which would cause pain if applied to the skin. To be sure when either the heat or cold reaches a pitch that it would cause pain in the skin the fluids may certainly give rise to a sensation in these internal parts belonging to general sensation, but it is weak and is not the sensation of warmth or cold, and still less is one able to distinguish between gradations of heat and cold."*

Haller described the parietal peritoneum as a structure-

* Steinhäuser, "Experimenta nonnulla de sensibilitate et functione intestini crassi," Leipzig, 1831, p. 19 (quoted by Weber).

less, indifferent membrane, with little or no sensibility. Of the visceral peritoneum of the bowels he says that it is but slightly vascular and possesses no feeling. He held it for very probable that the mucous membrane of the intestine was not endowed with sensation, but that on the other hand the submucosa was specially sensitive, as in it the nerves are found. In Haller's time, however, all nerves were supposed to be sensitive. The intestinal mesentery, which probably to Haller meant only the two serous leaves, he describes as having no nerves, and therefore no feeling. The viscera (heart, lungs, liver, spleen, and kidneys, he believed to have but little sensation.*

Haller was also of opinion that the visceral peritoneum had no sensation. It must be remarked, however, that in

* Halleri, "Elementa Physiologiæ" (1757-1766), T. v., Bk. xx., "Vela-menta Abdominis" (Membranes of the Abdomen), Sectio i., § 1, pp. 340-341: "The peritoneum has but little or no feeling, for the nerves which follow it appear to supply the abdominal muscles. The eminent Van Den Bos, however, has stated that it is possessed of sensations, but, as he has himself recognised that the outer surface of the stomach and bowel is not painful to the touch, this celebrated man answers himself, for these outer surfaces are covered by peritoneum. But even Radmiczkyo, for whom the question of the sensibility of the tendons was answered, appears to have been still undecided in regard to the serosa. Further, Lorry states that it possesses no sensibility. But no matter what opponents may say, it is neither irritable nor does it possess fibres." (This is as much as to say that the peritoneum is a structureless membrane.)

Tom. vii., Liber xxiv., "Intestina," Sect. i., § 7., "Membrana Extima" = visceral serosa, p. 16: "The visceral serosa is only slightly vascular and has no sensation." Sect. xi., "Tunica Villosa" = m. membrane, p. 23: "Although I believe that the mucous membrane is itself without feeling, being the analogue of the epidermis, nevertheless sharp agents (acria corpora¹) brought in contact with it may produce the most severe pain, because it only provides the thinnest possible covering to the nerves (which run in the tunica nervosa = sub-mucosa)."

Tom. iv., Liber x., "Cerebrum et Nervi," Sect. vii., "Phenomenon vivi Cerebri," "Sensus"; § xi., "Viscerum parium sentiunt" = "The viscera have but little feeling. Perfectly definite nerves pass to the heart, lungs, liver and spleen, and consequently these viscera cannot be without sensation, and more than all the lungs, in which lie the bronchi, whose highly sensitive internal membrane is a direct continuation of the external skin. Experiments, however, on living animals and diseases show a slight sensitiveness in these organs, the liver, spleen, kidneys, and indeed in the lungs."

(2) Albertus de Haller, "De partibus corporis humani sensibilibus et irritabilibus" (April 22nd, 1752), pp. 114-158, *Commentarii Societatis regię Scientiorum Gottingensis*, T. ii., ad Annum mdcclii., Gottingiæ, 1753.

¹ Acria may be understood to mean either acrid chemical fluids or sharp or pointed solids.

the experiment with the pleura and parietal peritoneum these structures were exposed by dissecting away all their coverings; the ribs, muscles, and areolar tissue, &c., and also of all nerves visible to the naked eye.

Haller also uses the term sensibility in accordance with the state of knowledge of his time as synonymous with sensibility to pain. "I call those parts sensitive in which on their being irritated the animal shows signs of discomfort or pain." As soon as an animal under operation winced he held the part to be sensible, that is to say, painful.

After my article "On the Sensibility of the Abdomen" had been published in the *Centralblatt f. Chirurgie* and the foregoing pages had been long written, Prof. Bier, of Griefswald, H. Braun, of Göttingen, F. Hofmeister, of Tübingen, and J. Veit, of Leyden, were all good enough to send me their views on the points in question either by letters or "Reprints" of essays they had written. In his work on "The Origin of the Collateral Circulation" * Bier, speaking of the sensibility of the bowel and stomach, says, "It is well known that the intestine possesses no sense for contact, touch, temperature or pain in the way that the external parts are endowed with these properties. Every surgeon knows that in the human being parts of the bowel may be cut, burned, pricked, or crushed in an operation for artificial anus in two stages without the least pain being felt by the patient. I myself, following Riedel, have undertaken extensive resections of the bowel with suturing of the ends in cases where one or two days before a loop had been drawn out for artificial anus. But particularly of late I have done numerous operations on the intestine, *e.g.*, a resection of the pylorus and a pyloroplasty under Schleich's excellent method of infiltration, the latter being applied to the abdominal wall. In both cases so far as adhesions had not to be dealt with both intestine and stomach were handled without the

* Aug. Bier, "Die Entstehung des Kollateralkreislaufs," *Virchow's Archiv*, Bd. cxlvii., 1897; Bd. cxlviii., 1898.

slightest pain. A strong tug on the mesentery was felt in the one case as general abdominal pain, in the other as a cause of vomiting. . . . The same intestine which may be burned, cut, pricked or crushed may nevertheless suffer the most fearful pain. One has only to think of the torture in certain diseases which affect the intestine and the intense suffering of chronic obstruction of the bowel."* He then adds an observation which he had made which goes to show that a violent, almost spasmodic contraction of the bowel may take place without any consciousness to the patient of discomfort. This was the case of a woman with a femoral hernia as large as a child's head and with very thin coverings. By the use of external stimuli Bier found that the wildest peristalsis was produced in the included loops of bowel. The patient heard the gurgling in the bowel, but was otherwise unconscious of it. At the end of this essay the same author has added some remarks upon the sensibility within the abdomen. In a wider experience with Schleich's method it has happened to him that the patients suffered so much pain that he had to interrupt the local and substitute general anæsthesia for it. "Thus in an attempt to remove the vermiform appendix the drag upon the cæcum gave rise to nausea, belching, pain at the umbilicus and faintness. In resections of the stomach the ligature of the omenta caused much dragging pain. Difficulties were also met with in extensive excisions of the intestine."† The last-mentioned case was one in which an extensive resection of the bowel was done for gangrene. On this he says, "Drag upon the loop of bowel produced pain at the umbilicus ('like a labour throe') and ligature of the mesentery was very painful. On the other hand gradual squeezing of the latter with forceps and division with scissors or thermo-cautery was not felt

* P. 455, Bd. cxlvii.

Prof. Bier, so far as I know, has written nothing on the sensibility of the abdominal contents except the above, but he has told me that he has made many observations thereupon which he has not yet published.

† *Ibid.*, Bd. cliii., pp. 446 and 465.

at all. The bowel itself was insensitive to every form of irritation." According to Bier then pain is only felt in those operations in which the posterior wall of the abdomen is dragged upon.* Bier continues, "I must therefore add to my former conclusions that the separation of adhesions and ligature of the mesentery are both always exceedingly painful." He makes no distinction between adhesions with the abdominal wall and adhesions among the intestines themselves. But separation of adhesions between the intestines and the abdominal wall involves almost certainly stretching of the parietal peritoneum and is therefore painful. Separation of adhesions, on the other hand, which do not touch the abdominal wall is not painful, as we shall see directly.

H. Braun, writing in the "Handbuch für prakt. Med.," Bd. ii, 1900, p. 1,125, among his general remarks on laparotomy, says: "Infiltration with weak solutions of cocaine by Schleich's method, or with B. eucaine, is only to be employed in very feeble patients, who, owing to collapse, are unfit for general anæsthesia, or on whom it is only intended to perform some short operation. When any long operation is in view local anæsthesia is unsuited for laparotomy, since, even with good infiltration of the subperitoneal tissues, complete insensibility is not produced, and the patient groans and strains whenever the parietal peritoneum is interfered with."

In a report on twenty-five cases of gangrenous hernia treated in Prof. v. Brun's Klinik between April 1st, 1896, and January 1st, 1900, Franz Hofmeister† remarks: "On principle herniotomy is done here under infiltration anæsthesia after previous hypodermic injection of 0·01 to 0·02 gr. of morphia." After admitting that "division of the ring and separation of the sac are productive of severe pain," he adds: "But it is very striking how entirely insensitive the bowel is; one can count upon the patient sleeping

* At least this is my conception of Prof. Bier's remarks. (Lennander.)

† *A propos* of Lennander's essay.

‡ Hofmeister, "Ueber die Behandl. brandiger Brüche," v. *Brun's Beitr. Klin. Chir.*, Bd. xxviii., 3, pp. 672-673.

throughout the resection and suture of the intestine as quietly as under chloroform."

In February, 1901, Prof. Veit wrote to me that he had performed conservative Cæsarian section four times with the best results without any general anæsthesia. He does not deliver the whole pregnant uterus out of the abdomen, and does not compress the neck of the organ. When the latter has been brought into the middle line the skin is infiltrated with one or two syringes full of Schleich's No. 2 solution.*

That all surgeons do not regard the bowel pulled out to form an artificial anus as insensitive appears from a communication regarding Eucaine by Törnqvist †: "Besides, for subcutaneous injection eucaine is used as a local anæsthetic in painful wounds, and before the division of the intestine for artificial anus. Here 20 per cent. in ointment consisting of olive oil and lanolin is applied."

A particularly interesting work has recently come under my notice by Max Buch, of Finland, entitled "Sympaticus-neuralgier som symtom af ett patalogiskt irritations stillstand hos sympaticus." ‡ I can recommend this essay to all who desire to study the history of the whole question. In it are numerous quotations, especially from the older authors. According to Buch (p. 238) Bichat noticed at the end of the eighteenth century that electrical, chemical, and mechanical irritation of the organs supplied by the sympathetic do not produce pain, but at the same time he thought that the sympathetic could be the seat of neuralgias. It remained for Majendie to show that this was not possible. He found that pain cannot be provoked in any part of the sympathetic. According, however, to Buch this is only true of the nerve of healthy animals, for Wutzer, Flourens, Brachet, Valentin, and Longet, he states, have shown that when the sympathetic has been long exposed to an electrical stimulus, or when hyper-

* Veit, "Sectio Cæsarea," Eulenburg's *Encyclopäd. Jahrb.*, Bd. ix.

† Törnqvist, "Om användningen af allmän och lokal bedöfning, &c.," published by Prof. Borelius in April, 1901, pp. 106-107.

‡ *Finska läkaresällskapets handlingar*, 1901, No. 3, pp. 234-255.

æmia or inflammation is induced in it, all parts of the nerve become sensitive, and the ganglia more than the trunks. And so early as 1800 it was stated by Sömmering that pain can be produced in the sympathetic when it is stretched or pressed too much (Buch, *ibid.*). In regard to the vagus Buch's investigations on the rabbit led to the same result as those of Claude Bernard and Budge, namely, that the abdominal vagus is absolutely insensitive to every stimulus, whether faradic or mechanical. Buch on the strength of his literary studies comes to the conclusion that "it is now a firmly-established fact that every part of the sympathetic may be the carrier of pain," and that therefore "hyperæsthesia and neuralgia may be present in all parts of the sympathetic," which is equivalent to saying that all organs innervated by the sympathetic may be the seat of hyperæsthesia and neuralgia. On this hypothesis he founds the theory of a special condition which he calls sympathetism, by which he explains a great part of the pains which we suffer from in the head, chest, and abdomen.

On the basis of observations which I have already recorded and of others to be reported presently, it now appears necessary to pause and inquire whether an organ innervated from the sympathetic or the abdominal vagus can be the seat of pain or sensation. Was not Majendie right when he asserted that the sympathetic was under all circumstances insensitive? But even if one shares Majendie's view, that does not prevent one from admitting the possibility of a primary affection of the sympathetic which might lead to a diseased condition in the intestines. Nevertheless, one must be pardoned a certain amount of scepticism in regard to a symptom described by Buch and many others with him as a sign of disease, as "sensitive-ness to pressure over the sympathetic of the neck and loins," to which he gives much weight. For it is impossible to exert pressure upon the cervical sympathetic, the coeliac plexus, or the lumbar trunk of the nerve without at the same time pressing upon numerous sensitive nerves of the cerebro-spinal system.

In examining this question experiments on animals are of very little use. Tests of pain on animals have essentially very little value, and still less for determining corresponding conditions in man. We have only to remember how soon an intelligent patient who is anxious during an operation to give correct answers becomes weary and impatient, and experiences difficulty in distinguishing at a given moment the pain of this or that manipulation from the unpleasant and often tormenting impressions which are incidental to the whole operation. When we know this we are justified in great caution in drawing conclusions from analogous observations on animals. To this may be added that the animal most frequently employed, the rabbit, is thrown by fright into a kind of general rigidity in which he often ceases to react even to the most painful stimuli. As far as my experience goes, when patients are operated on under local anæsthesia one can only depend safely upon their statements in regard to the sense of pain for a short time, varying with the individual. Sooner or later, and with some very soon, they become impatient and fatigued, and are unable to say what it is which is producing pain, and often complain of manipulations which all our experience goes to show are not productive of pain. This is a condition to which I have applied the term "pain tetanus," and in it I see an indication to resort at once to general anæsthesia unless the operation is to end within a minute or two.

Glancing back at the results of our inquiry into the literature of the subject, it seems probable that at the time at which my first publication on "The Sensibility of the Abdominal Cavity" saw the light most medical men had forgotten the observations of Haller, his predecessors, and contemporaries of Bichat, Majendie, &c. Many surgeons, however, believed, as the result of their experience in operations, that healthy intestines have little or no feeling. In regard to the question of the sensibility of the parietal serosa opinions were divided. But no one, so far as I know, before myself has endeavoured to show

that all pains felt within the abdomen during operations or in disease are to be referred to parts which are innervated by the intercostal lumbar and sacral nerves, *i.e.*, to the diaphragm and abdominal walls, as well as to such organs of which we know with certainty that they are innervated by the nerves in question or are in near relation to them. These are the capsule of the kidney, the ureters, the pelvis of the kidney, the duodenum, and the retro-peritoneal portion of the ductus choledochus, &c.

The only way in which we can clear up this difficult point is by recording accurately and in detail the statements of patients in regard to pain and sensations and compare them with our observations during operations and dissections.

The observations of Head,* Faber,† and others on disturbances of sensation in the walls of the chest and abdomen, such as hyperæsthesia to pressure in the intercostal spaces, will also probably be of assistance here.

PARIETAL PERITONEUM. GALL BLADDER. ADHESIONS BETWEEN ABDOMINAL VISCERA.

We learn from the following case (5) and others that the parietal peritoneum derives its sensibility from the intercostal nerves in the subserosa. If such a nerve be divided the parietal peritoneum on the distal side becomes insensitive over an area corresponding to the distribution of its twigs, which is not, however, large. This depends upon the fact that the areas of distribution of different twigs are common to both. In Case 5 it will be seen that a gall bladder which was adherent to the omentum and transverse colon and whose mucous membrane showed marked catarrh—it contained a gall stone as large as a plum—was entirely without sensation. The patient had no feeling either of pain or touch during all the manipulations of the operation necessary for a cholecystotomy with so-called “water-tight drainage.”

* *Brain*, vol. xvi., 1893, pp. 1-130.

† *Hospitalstidende*, 1899, Nos. 13-16.

As it seemed desirable to produce adhesions between the anterior surface of the liver and the abdominal wall in the neighbourhood of the gall bladder, the serosa of the former was destroyed over a considerable area by various means such as silver nitrate, thermo-cautery, scratches with a needle, &c. The surface of the liver proved to be destitute of all sensation either of pain or touch. It was the same when the anterior border of the liver was pinched between the finger and thumb. The adhesions also between the gall bladder, the omentum and mesocolon were insensitive, as also the two last structures.

CASE 5.—F., aged 64, admitted December 3rd, 1900. Biliary colic with tedious fever for fifteen months. Great weakness and diffuse bronchitis in both lungs. In the urine both albumen and granular casts. General anæsthesia contra-indicated. December 3rd, $\frac{3}{4}$ cgr. morphia and Schleich's infiltration. Notes: "The gall bladder was adherent to the transverse mesocolon and moderately full of dark green bile. The mucous membrane was red and swollen, but without ulcers; one calculus the size of a plum lying in the entrance of the cystic duct."

Microscopically and bacteriologically the bile showed *B. coli* com. and another rod-like organism which reacted to Gram's stain, but could not be further differentiated.

During the whole operation the patient remained perfectly quiet and to each question in regard to pain gave a clear and intelligent answer.

Notes specially directed to the question of pain during cholecystotomy with "water-tight drainage" of the gall bladder. The omentum was stitched to the latter. Iodoform gauze packing between liver and abdominal wall.

The first incision was parallel to the right rectus and at its outer border.

Division of the aponeuroses of the oblique produced pain. How far the pain was present at every point or only where small nerve-twigs were divided is uncertain. Nevertheless the pain which follows division of the aponeurosis may clearly be severe. After infiltration

between the aponeurosis of the external oblique and between the internus and transversalis muscles, these structures can be divided without any expression of pain on the part of the patient, but only those parts involved in the artificial œdema. The same holds for the transversalis muscle both before and after infiltration after Schleich.

On division of a nerve in the abdominal wall a momentary pain was felt.

In the area supplied by the divided nerve no pain was felt in the parietal serosa either when incised or pinched with artery forceps, &c., but outside of this area severe pain was produced by the same stimuli. After infiltration of the extraperitoneal areolar tissue the p. parietale became insensitive over the rather limited area efficiently charged by the fluid. In the other parts not reached by the anæsthetic the pain on manipulation of the p. parietale was always severe.

Stretching of the abdominal wound with rounded hooks produced severe pain.

When the peritoneum had been opened the mesial part of the same was found to be insensitive (the nerves supplying it had been gradually divided), but the outer part of the peritoneum was still very sensitive to pain.

Palpation within the belly : of the gall		
bladder and its neighbourhood	..	Pain.
Gall bladder : gentle palpation of the		
fundus so that the lumen of the sac		
was pressed together without stretch-		
ing or contact with the abdominal		
wall	.. .. .	No sensation.*
Drawing forward of the gall bladder	..	Pain.
Three artery forceps were applied to the		
serosa of the organ	.. .. .	No sensation.
Silver nitrate to the serosa of the organ	..	No sensation.
Drying of the serosa with gauze	.. .. .	No sensation.

* When this is stated it means that no other sensation was present.

Burning of the serosa of gall bladder with the thermo-cautery	No sensation.
Powerful compression of the gall bladder between the fingers	No sensation.
Drying of the surface of the liver with gauze	No sensation.
Cauterisation of the surface of the liver with silver nit. thermo-cautery, and scratching with needles	No sensation.
Drawing forward of gall bladder and division of adhesions with thermo-cautery	Pain.
Division of adhesions between the gall bladder and omentum with thermo-cautery	No sensation.
Division or cauterisation of adhesions between the trans. m. colon and gall bladder behind	No sensation.
P. Peritoneum drawn with hooks on mid-line of the wound	No sensation.
On outer side of the same	Severe pain.
Introduction and removal of gauze between p. parietale and omentum ..	Pain.
Opening the abdominal wound in order to introduce gauze packing	Severe pain.
Grasping the whole thickness of the gall bladder with Péan's forceps	No sensation.
Puncture and aspiration of the gall bladder	No sensation.
Incision of gall bladder with thermo-cautery	No sensation.
Palpation of its interior with the finger ..	No sensation.
Compression of gall bladder upon the large calculus behind	Pain.
Extraction of the stone with a large spoon introduced with the finger	No sensation.
Plugging of the gall bladder with iodoform gauze as far as cystic duct	No sensation.
"Tobacco-pouch" suture round the opening in the viscus with a large needle for "water-tight" drainage	No sensation.

Introduction of a drain tube and closure of the above suture, lasting a minute ..	No sensation.
Removal of tampons between omentum and transverse colon	No sensation.
Introduction and removal of gauze tampons between liver and parietal peritoneum	Severe pain.
Suture of omentum round gall bladder ..	No sensation.
Ligature of vessel in wall of gall bladder ..	No sensation.
Compression of transverse colon between fingers	No sensation.
Application and knotting of sutures between the gall bladder and p. parietale of the median side of wound	Little or no pain.
On the outer side	Severe pain.
Plugging on the inner side of the wound ..	Slight pain.
On the outer side	Severe pain.
Application of Péan's forceps on either side of the wound showed the same results.	

This operation, performed before my class, afforded me the greatest satisfaction, inasmuch as the imperturbable quiet of the patient gave the best guarantee that what she said in regard to pain or no pain was correct. After the abdomen had been opened it was clear that the pain was produced by stretching of the parietal peritoneum and the parieties with hooks, and further by friction of the compresses on the parietal serosa during their unavoidable introduction and withdrawal.

The patient had no pain after the operation, and improved daily. Some of the bile escaped by the tube, some into the bowel. Later on she grew weaker, and her icterus deepened = cancer of liver.

On the same day as this last operation we were able to make two other observations on the sensibility of the parietal peritoneum. In both cases incisions were made in the abdomen above both ligamenta Poupartii and the adjacent part of the iliac crest.

CASE 6.—Laparotomy, December 6th, 1900. J. E., 705 B. Fracture of the pelvis, bleeding under and within the peritoneum, complete rupture of the urethra.

No general anæsthesia. Patient was almost insensible. No part of the operation produced so much pain as the division of the parietal peritoneum, not even the cut in the skin, although it had not been anæsthetised.

In relation to the parietal peritoneum and the gall bladder I have a further observation which shows that the first is absolutely insensitive in parts in which it has been deprived of its nerves, and that the latter, in a case in which cancer with distension of the gall bladder was present, was entirely without feeling. (Case 7, see original.)

One of my friends has stated to me that he is convinced that an ulcerated gall bladder is painful, for when after a cholecystotomy he irrigates the viscus or touches its inner surface with a probe suffering is produced. I believe that this is due to the fact that when this operation is done and the gall bladder is firmly sutured to the parietal serosa, the viscus contracts under the stimulus of the irrigation or probe, and thereby the parietal peritoneum is stretched, and consequently pain is felt. Whether the gall bladder is or is not ulcerated, I do not believe that this has the slightest influence upon its sensibility to pain, unless the inflammatory process has extended to the muscular coat, and thereby increased its irritability so that it contracts more energetically to slight stimuli than under ordinary conditions. During the last half year I have had three cases in which the gall bladders were much diseased, and in which it was impossible to stitch them to the parietes. I was therefore compelled to be satisfied with packing round each with gauze. After the removal of the latter the viscus in each case lay of course between the liver, duodenum, mesocolon, and transverse colon, together with the omentum. One was a case of acute diffuse peritonitis, owing to acute cholecystitis, with commencing gangrene of the gall bladder. All three

recovered. When in these cases the gall bladder was washed out or the inner surface was touched with metal instruments no pain was produced, unless one came too near to the edges of the abdominal wound.

From this and other cases operated on before it, I have drawn the conclusion that in general it is better in performing cholecystotomy not to suture the gall bladder first to the parietal peritoneum. This avoids on the one hand a possible kinking of the bile ducts when the liver shifts its position a little, and on the other the pain due to any distension of the gall bladder with bile. If the condition of the walls permit one can always resort to the so-called "water-tight drainage" for the first eight or ten days.

Within the last few weeks I have had another case (No. 8) illustrating the same points. (Case omitted, *vide* original.)

PARIETAL PERITONEUM. ILEUM. MECKEL'S DIVERTICULUM.

Cases 9 and 10 afford further evidence on the sensibility of the parietal peritoneum. Case 9, like No. 1, shows that the small bowel is insensitive to compression and stretching. The same is true of the mesentery, provided that the stretching is not in a direction forwards, which puts a strain on its attachment to the posterior wall of the abdomen. It is a point of very great interest that none of the patients had any consciousness that a portion of their intestine was drawn through a wound in the abdominal wall, that the patient in Case 10 was unaware of violent contractions in a Meckel's diverticulum, and that likewise the patient in Case 9 had no feeling for an extremely violent peristalsis until the latter extended widely into the rest of the abdomen, where it must have affected the coils adherent to the parietal peritoneum by a mass of adhesions.

CASE 9.—M. S., No. 693 B., a sempstress, aged 39, whose v. appendix I had extirpated on March 26th, suffered during the summer and autumn from ever-increasing constipation and pain in the abdomen. The diagnosis was extensive fibrous peritonitis, especially in the true pelvis and about the S. flexure. As the operation promised to be tedious, it was done under local anæsthesia through the right rectus sheath, the muscle being drawn outwards (December 5th, 1900). The coils of intestine which forced themselves through the wound were closely observed, but as there were numerous adhesions, both anteriorly and posteriorly, general anæsthesia was at once begun. All the adhesions were divided or extirpated, the most important being apparently those which pressed upon and kinked the S. flexure. It was also necessary to remove the widely-diseased uterine adnexa on both sides.

Notes on the pain during operation :—

*Abdominal wall.**—Schleich's infiltration was employed after the anterior rectus sheath had been opened, and before the separation of the rectus† between the muscle and the posterior sheath. This produced an œdema between the fascia transversalis and peritoneum downwards from the linea semilunaris of Douglas; but, on the other hand, not between the proper sheath of the rectus and peritoneum above this line.

Division of the posterior sheath corresponding to this line	..	..	..	No pain.
Application of Péan's forceps	..	..	..	No pain.
Division of the parietal peritoneum in the œdematous region	..	..	..	No pain.
Application of Péan's forceps	..	..	..	No pain.
Division of the posterior rectus sheath above the œdematous line	..	..	..	Severe pain.

* In the following reports the anæsthesia of the skin, &c., is not mentioned.

† The author's method of incision through the sheath of the rectus with pulling of the inner border of the muscle was here employed (see below).

Péan's forceps Severe pain.

Another injection was now made into the rectus sheath and peritoneum, after which they were divided without pain.

Small intestine.—On opening the peritoneum a coil of small intestine forced itself out, and soon showed such violent contraction that its lumen was completely obliterated *pro tem*. The patient was quite unconscious of this. But when another couple of coils protruded and contracted in the same way pain was felt in the interior of the abdomen. This is not to be wondered at when one thinks of the extensive adhesions between the small bowel and the parietal peritoneum, as well as the root of the mesentery which were subsequently found.

In respect to the small bowel and its mesentery the following was observed :—

(1) When one or more coils were protruded through the wound the patient was absolutely unconscious of the fact, and was free of pain.

(2) Firm pressure on the gut between the finger and thumb without drag on the mesentery did not produce the slightest sensation either of pain or touch.

(3) Firm compression between the fingers at two points and simultaneous stretching of the intervening portion in its long axis without strain on the mesentery evoked neither pain or sense of touch.

(4) The same compression of the mesentery without drag, *idem*.

(5) The same with stretching which did not affect its attachment to the posterior wall of the abdomen, *idem*.

(6) Slight strain on the mesentery forwards (= pull on its attachment) produced pain, referred to the umbilicus.

Parietal peritoneum.—Gentle palpation of this with the finger on its inner surface produced pain which became intense when the palpation was firmer. This was quite correctly localised as to side. The pain was independent of any contact with the edges of the incision in the abdominal wall.

Stretching of the abdominal incision.—Application of large round-edged hooks like Doyen's pattern and lateral stretching of the wound caused severe pain. After their removal the pain disappeared gradually.

The S. flexure was strongly contracted and hardly the size of the index finger. It was drawn up out of the pelvis, and the consequent stretching of the mesosigmoid produced pain.

After this general anæsthesia was produced.

The patient bore the operation extremely well. The abdominal wound healed by first intention, and the patient was freed from her abdominal pains. She showed herself at the end of March, and stated that she enjoyed every kind of food, and her bowels acted regularly every day. But from a communication received at the end of July she is not so well.

CASE 10.—A. G. B., aged 60, workman, No. 870 A., 1900. R. ing. hernia; reducible. Patient had been admitted on December 5th for a severe injury to the left side of the thorax. He was so tormented with bad cough that general anæsthesia was not employed.

December 15th.—Bassini's operation for radical cure. Infiltration by Schleich's and Cushing's method = infiltration of inguinal nerves, and (?) middle branch of genito-crural.

Towards the end of the operation $\frac{3}{4}$ cgr. morphia.

Note on sensibility :—

Sac and parietal peritoneum.—The portion of parietal peritoneum in and around the neck of the sac was very sensitive to cutting, stitching, pinching with forceps, and especially to stretching, while similar stimuli in the fundus and body of the sac caused no pain. During the operation on the sac itself the patient volunteered the remark that "the pain went through the bladder."

The most severe pain was felt when the parietal peritoneum was drawn upon in suture of the sac, and above all when a small portion of gauze was packed into the neck and withdrawn, as the three-finger broad opening was closed by knotting the sutures.

Meckel's diverticulum.—This was found in the sac, and was five inches long and as thick as the finger. It was removed in the same way as the v. appendix in a typical operation. Here neither compression with forceps, suture, ligature, or rubbing with silver nitr. or the thermo-cautery caused any sensation of touch or pain. The drawing together of the bowel wall and invagination of the stump by means of the tobacco pouch suture caused no pain.

The contractions in the distal part of the diverticulum were so powerful that it became quite white, and felt like a hard rugged tumour, but the patient felt nothing of it.

Stretching of the spermatic cord, whether during its separation or when held upon hooks out of the way while the deeper layer of sutures was placed according to Bassini's method, caused no pain.

The patient ate his dinner after the operation, and the wound healed *per primam*.

Before leaving the observations on the peritoneum parietale I should like to note a remark of one of my former assistants, Dr. O. Olsson.

He writes, May 31st: "In several laparotomies under infiltration anæsthesia I have been convinced that the parietal peritoneum is extremely sensitive. Cuts of it are painful, and also pressure with Péan's forceps on its edge, even when no traction is made.

VERMIFORM PROCESS, CÆCUM, AND LAST PART OF THE ILEUM.

Cases 11, 12, and 13, show that a diseased vermiform appendix and its mesenteriolum also exhibit no sensitiveness either to pain or touch during operations, provided there is no dragging upon them, and through them upon the posterior wall of the abdomen. The same is true of the cæcum, and the last part of the ileum, with its mesentery. Each of the cases was affected with chronic epityphlitis, with the usual changes in the mucous mem-

brane, &c. In all of them an elongated mass was felt and described as a swollen vermiform process.

CASE 11.—F., aged 15, No. 354 A., 1900. Admitted November 9th. In this case there was no special detailed report as to pain. I therefore give the report of the operation as dictated by myself.

November 13th.—The appendix lay, as was expected, to the inner side of the cæcum in the upper part of the iliac fossa, close to the linea terminalis. Local anæsthesia as above. The incision was then made without pain longitudinally through the anterior rectus sheath.* Only one nerve was then seen running transversely at nearly the level of the umbilicus. Into this nerve 1 gr. of a $\frac{1}{2}$ per cent. solution of cocaine was injected, and afterwards the connective tissue was cut across without pain, and could be drawn upwards and downwards, exposing the posterior rectus sheath and the peritoneum. The latter was now divided directly behind the skin incision. The appendix lay just as expected. It was 5 to 6 cm. long and kinked. It was double as thick at its distal end than it was proximally. Its mesenterium was firmly adherent in the iliac fossa by fibrous adhesions of the peritoneum, which was the cause of the kinking of the appendix. It was therefore difficult to draw the latter adequately into the wound during its amputation, which was done in the usual way. A catgut ligature was applied at its base, and it was burnt through between this and forceps placed on it about $\frac{1}{2}$ cm. off. The vessels of the mesenterium were secured with a catgut ligature, and then the stump of the epityphlon was invaginated in the wall of the cæcum and secured with a "tobacco-pouch" suture. The cæcum and appendix appeared to be absolutely insensitive, whether to needle, toothed forceps, or cautery, but pain was produced as soon as the cæcum was drawn forward and its mesentery dragged upon the posterior abdominal

* Incision described by myself, *Rev. de Gyn. et de Chir.*, Sept.-Oct., 1900; also in abstract in *Upsala läkarefören. förh.*, 1897-1898, and *Centralb. f. Clin. Chir.*, 1898, No. 4, p. 90.

wall. Pain was also present during the drawing out of the edges of the parietal peritoneum into the wound; this and its suture were consequently the most painful parts of the operation. The anterior rectus sheath was stitched with two rows of No. 4 catgut, the skin with silk-worm gut. Three-quarters of an hour before the operation the patient received $\frac{1}{2}$ cgr. of morphia and another $\frac{3}{4}$ cgr. at the beginning of the operation. There was nausea during the whole procedure, and she vomited a few times.

I never saw more quiet during an appendectomy. The patient seemed quite free from trouble when put to bed. This may have been due to the morphia in part, but more probably to the fact that when the patient had quite got over her nausea she had no more involuntary contractions of the abdominal muscles. There was no fever; union *per primam*.

CASE 12.—Hanna L., No. 338 A., 1900. Suffered long from chronic epityphlitis, and lay in bed for the last month on restricted diet. Her admission was hurried on account of an acute Ot. M. purulenta, which I opened. She was very weak, and gladly agreed to local anæsthesia for the excision of the appendix.

November 30th.—The same incision as above (Case 11), $\frac{3}{4}$ cgr. morphia before operation. Schleich's infiltration.

Division of the anterior sheath of the	
rectus generally	No pain.
(but patient believes she felt touch)	
In certain points, apparently nerves ..	Severe pain.
Division of posterior sheath, <i>idem</i> .	

In this case, as no single large nerves could be seen, it was impossible to infiltrate them. Later one large nerve was seen above the incision, and another immediately below it. Numerous small twigs were visible in the posterior sheath of the rectus and transversalis fascia. Stretching of the subserosa of the parietal peritoneum caused severe pain. Cuts in the parietal peritoneum along the whole abdominal incision produced some pain, but

more marked at particular points corresponding to divided nerves.

Suture at base of appendix.. ..	No pain.
Application of Péan's forceps to appendix	No pain.
Burning with thermo-cautery of—	
(a) Serosa of appendix	No pain.
(b) The whole appendix through ..	No pain.
(c) A part of the mesenterium ..	No pain.
Ligature of mesenterium—	
At one point	Pain.
At another point	No pain.
Local stretching of the mesenterium, <i>e.g.</i> , by introduction of ligature	Momentary pain.
Division of mesenterium beyond ligature	No pain.
Drag on mesentery with fingers gave pain in pit of stomach.	
Thermo-cautery to the serosa of the cæcum round the stump of the appendix ..	No pain.
Tobacco-pouch suture in the cæcum ..	No pain.
Knotting of these sutures	Slight pain.
The cæcum and mesenterium were so fixed to the posterior wall that it was almost impossible to draw upon the sutures without pulling upon the latter. When this was done the patient referred the pain to the pit of the stomach	Pain.
Pinching of the healthy gut without dragging on mesentery	No pain.
Stretching of the gut in long axis without pulling the mesentery.. ..	No pain.
Pinching the mesentery between the fingers	No pain.
Stretching the abdominal wound with hooks	Severe pain.
Replacing the coils	Severe pain.

Then followed short general anæsthesia for suture of the opening, and "revision" of the ear affected with otitis media.

Convalescence perfect without reaction.

CASE 13.—K. P., housewife, age 37, No. 367 A., 1900. More than three years before patient had been for several months ill with appendicitis. Never able to work since, and for months in bed owing to relapses. At the operation widely diffused fibrous peritonitis due to chronic epityphlitis, and a right-sided extra-uterine pregnancy. Only the skeleton of the foetus found; probably at least in fourth month.

Foreseeing a tedious operation I proposed local anæsthesia as the patient was very weak, to be followed by general anæsthesia if desired.

December 7th.—Oblique incision over the right iliac fossa, prolonged across the rectus and linea alba, and ending in a longitudinal incision through the sheath of the left rectus and the parietal peritoneum.

Schleich's infiltration of the abdominal wall after $\frac{3}{4}$ cgr. morphia.

Parietal peritoneum :—

(a) Without infiltration.. ..	Severe pain.
(b) After infiltration between trans-	
versalis fascia and peritoneum ..	Slight pain.
Omentum pinched with Péan's forceps ..	No pain.
Appendix crushed with Péan's forceps in	
several places	No pain.
Tobacco-pouch suture at base of v.a. and	
tying of same	No pain.
Division of v.a. by cautery	No pain.
Cæcum—nit. silver to serosa	No pain.
Cæcum—serosa touched with thermo-	
cautery	No pain.
Mesenterium of appendix divided with	
cautery	No pain.
Mesenterium caught with Péan's forceps	No pain.
Drawing forward of mesenterium even	
a little,	Pain.

Even when there is no drag upon the abdominal wound and thereby no trace of pain in it a pull upon the mesentery without simultaneous contact with the anterior peritoneum or wound causes	Severe pain
Suture of the mesenteriolum	No pain.
Knotting of ligatures in the mesenteriolum when the latter is pressed towards the posterior wall to avoid drag	No pain.
If the mesenteriolum is dragged forwards in the very least in knotting ligatures	Pain.
Under ether narcosis which was so slight that patient called out when the parietal peritoneum was manipulated or the wound stretched with hooks, severance by cautery of the anterior fold of the peritoneum of the ileocæcal fossa and stitching of this fold over the sutures in the cæcum and mesenteriolum.. .. .	No pain.
Small intestine stretched longitudinally ..	No pain.
Mesentery of small intestine pulled forward	Severe pain.

After this the incision was prolonged, and the extra-uterine foetation was extirpated under ether anæsthesia. Rapid recovery. Union *per primam* as far as the wound had been stitched up.

After this observation it is natural to enquire, what is McBurney's point?

I believe it represents the spot at which in most human beings the lymph vessels from the appendix pass on to the posterior abdominal wall—that is to say, the spot at which the abdominal wall is first involved in a lymphangitis or lymphadenitis. The serosa then at this point, with its numerous cerebro-spinal nerves, is inflamed.

If, then, a chronic inflammation is set up in the retro-peritoneal lymph glands hyperæsthesia around them must

last for a long time; but if, on the other hand, the lymphatics coming from the appendix in an acute case are thrombosed so that the toxins or microbes cannot be carried any longer to the posterior wall of the abdomen, the inflammatory changes here may be recovered from and sensitiveness to pressure may disappear, although the destruction of the appendix itself may advance further and further. In such a way the observation may be explained which is noted in Case 1 in Otto Lanz's extremely interesting communication on "The Indications for the Operative Treatment of Perityphlitis."* The case is as follows:—

A strong man, aged 25, suffered six months previously from a mild epityphlitis, and came to L. to have his appendix removed, because two of his friends had died of the disease after two and three attacks respectively. He was at the time absolutely free of any trouble. Palpation of the abdomen "negative." This, however, I venture to question in view of what L. found later in the vermiform appendix. I do not believe, namely, that in a healthy young man the v. appendix can be made out by palpation if normal. The author says on this point: "The v. process was to be felt under the palpating finger as an insensitive† cord which could be moved hither and thither quite distinct from the gurgling cæcum. It is apparently but little altered." Now how did such an insensitive Proc. Verm. look which, except for a short attack six months before, had caused the patient not the slightest trouble? Lanz gives a very good coloured sketch of it, and describes it as follows: "The proximal end of the lumen was completely obliterated, and on the distal side of the stricture were two intraappendicular abscesses full of muco-pus. These abscesses were separated from one another by a permeable stricture. In the proximal one was a deep ulcer corresponding to which was a purple prominence on the serous coat: *a threatened perforation without any clinical symptoms.*"

* *Korrespondenzblatt f. Schweizer Aertzte*, 1901, No. 1.

† Abstract by Lennander.

I cannot help thinking that a diseased appendix causes no distress or even abnormal sensation when it is not attached anywhere to the abdominal wall, or when toxines or microbes are not carried from it by the lymphatics to the subserous tissue of the posterior abdominal wall, producing there lymphangitis and lymphadenitis, or to the peritoneal cavity, causing the various forms of peritonitis (*conf.* tonsillitis with swollen glands). When the ascending colon and its mesentery are united to the abdominal wall in the usual way the lymph glands in the mesentery are practically retroperitoneal. In certain cases of appendicitis it is also probable that the lymph glands running along the iliac vessels and vena cava are affected, as a few of my operation cases appear to show. But as a matter of fact the course and anastomoses of the lymphatics coming from the vermiform appendix are far from being adequately ascertained.

When the ileum and ascending colon have a common free mesentery any discomfort or pain from a chronic "endo-appendicitis" must be felt in the pit of the stomach as well as above and around the navel. Here the toxines and microbes cause when absorbed a lymphangitis and lymphadenitis in the free, common mesentery, but first at the point of origin of the mesentery from the spinal column, *i.e.*, from the second and first lumbar vertebræ upwards. In this region the swollen glands may produce pain by pressure or stretching upon the surrounding cerebro-spinal nerves. It is also conceivable that toxic matters from the appendix may come in direct contact with these cerebro-spinal nerves through the lymphatics and cause pain through their chemical action without in any way stretching or pressing upon them. When the lymph channels and sensory cerebro-spinal nerves of this region have been thoroughly investigated it is possible that an explanation may be found for the observation made daily that at the outset of acute attacks of epityphlitis the pain has been felt commonly "in the pit of the stomach" above or around the umbilicus an hour or

two before it has been felt in the iliac fossa. We must not forget as bearing upon this point that when in an operation the mesenterium of the appendix or the cæcum is pulled upon forwards the pain is frequently located by the patient in the pit of the stomach.

When we meet with patients who suffer from symptoms of so-called gastric catarrh, but whose stomach and gall bladder appear healthy, we are justified in taking into consideration the possibility of the affection being connected with the appendix in one or other of its chronic troubles even when these patients have never experienced discomfort in the right side of the abdomen. The possibility of the colon and ileum having a common mesentery explains, as we have said, how a chronic or even acute endo-appendicitis may occur without any pain in the right side of the abdomen. That is to say, without some participation of the anterior or posterior leaf of the parietal peritoneum in the infection and inflammation there is no pain on the right side, unless there is lymphangitis and lymphadenitis in the subserous tissues of the right posterior abdominal wall, according to my opinion.

I have lately operated on two cases of diffuse suppurative peritonitis starting from acute epityphlitis, which show what a close relationship there is between the localisation of pain and the position of the appendix. One was a man of 35, in the fifth day of his illness, but whose doctor only recognised the gravity of his condition on this day. The operation revealed a general purulent peritonitis. The ascending colon and cæcum lay upon the right sacro-iliac articulation and sacrum. The gangrenous appendix hung over the brim of the pelvis in front of the sacrum and near to the middle line. The general infection of the peritoneum from the peri-appendicular pus had opened not only into the general cavity of the peritoneum but also into the ileum, so that the abscess contained fæces as well as pus. The doctor had not diagnosed epityphlitis "because the patient had neither pain nor tenderness to the touch in the right side." No examination of the rectum had been made.

Such peri-appendicular abscesses which lie in the opening of the pelvis behind or between the coils of small intestine, and which are so high that they cannot with certainty be palpated from the vagina or rectum, are, as a rule, difficult to diagnose just because they give rise to but little spontaneous pain and because one must press very firmly upon the anterior abdominal wall if the patient is to feel anything.

The other case which bears upon the same question was that of a lad of 17, with diffuse purulent peritonitis due to appendicitis. I operated twenty-six hours after patient had felt the first sense of discomfort in the abdomen, and fifteen hours after the onset of severe pain. The whole lower part of the abdomen was hyper-sensitive, but this was most marked in the anterior abdominal wall and outer part of the iliac fossa. Here the pain had been from the very start intense. There was marked oedema in the subserosa close to the anterior iliac spine and Poupart's ligament. The appendix had burst and was adherent to the anterior abdominal wall internal to the iliac spine.

In my first operations under local anæsthesia I endeavoured to answer the question: Has the mesentery no sensory nerves in those parts adjacent to the intestinal tube, or has it in general no such nerves? When my first paper on the subject was published in the *Centralb. für Chirurgie* I regarded it as certain that the mesenteries, including the mesenterium of the v. appendix, possessed no nerves in the parts usually operated on. Since then, however, a German and a Swedish surgeon for whose opinions I have the greatest respect have informed me that they regard this view as incorrect; in other words they believe that the mesenteries are sensitive. As far as the mesenteries of the large and small intestine are concerned my belief remains the same, *i.e.*, that an operation on them is painless so long as no traction is made upon the posterior abdominal wall. But as regards the mesentery of the appendix I shall now record one case from among others (*vide* original) which shows that in

certain cases it is hard to form a decided opinion as to what it is which causes pain in operating on the mesenteriolum—whether it is the traction on the posterior abdominal wall, or the injury to the part itself. Case 15*a* appears to speak for my view that it has no feeling.

CASE 14.—Med. student. Subacute appendicitis. April 29, removal. Before the operation Schleich's anæsthesia of the skin.

Packing of gauze into the abdomen .. Pain.

Drawing forward of the cæcum and adjacent part of the appendix causes pain of the same character as an attack of epityphlitis. During the subsequent few minutes, while the clamping of the appendix with forceps and its ligature was taking place, a continuous pain was complained of, which, however, was not aggravated by local manipulation. This pain gradually ceased, and on separation of the appendix by the cautery the patient felt nothing.

The suture of the cæcum on its anterior surface was painless, but posteriorly close to the mesenteriolum it was accompanied by pain = traction on the part. Knotting of the "tobacco-pouch" ligature on the stump also caused some pain.

Strain and separation of the distal portion of the appendix, which was everywhere adherent to the posterior parietal peritoneum, caused considerable pain.

Gripping of the mesenteriolum with Péan's forceps caused severe pain, indeed, the most severe of all. And it should be noted that in doing this all drag upon the part was avoided as far as possible.

Traction on the cæcum, and through it upon the parietal peritoneum, evoked considerable pain.

This patient had cardiac disease and was enfeebled by recent epityphlitis, hence the local anæsthesia. The conditions, however, for this were not favourable, as the cæcum and appendix, owing to adhesions, could not be drawn forward out of the abdominal wound. No traction could be made on them without risk of drag upon the posterior wall of the abdomen. The patient recovered quickly from the operation and was happy to have escaped general anæsthesia. Healing *per primam*.

CASE 15.—*Vide* original. In this case the cæcum and lowest part of the ileum were adherent to the posterior part of the abdomen. The former could not by any means be drawn into the wound. The appendix lay behind the cæcum adherent to it, to the ileum and to the posterior wall. It was therefore an unfavourable case for local anæsthesia.

It was of interest to notice in the last two cases that sometimes dragging, &c., upon the appendix and cæcum, sometimes manipulations about the area of the parietal peritoneum behind the lateral portion of the rectus, produced the same kind of pain felt by patient in attacks of appendicitis. This was specially noticed in the case of a surgeon on whom I operated. Having to deal with much superficial fat and a muscular wall, I was unable to find more than one nerve trunk (twelfth intercostal) going to the rectus. There was also much subserous fat. Having opened the peritoneum I cautiously inserted the finger. I could not do this, however, without some dragging upon the edges of the subserosa, and this was quite enough to provoke a severe not localised sensation of pain "exactly the same as in his attacks of appendicitis," as my friend said. Here the cause was only traction on the anterior parietal peritoneum.

CÆCUM.

Cases 16 and 17, with cæcal fistulæ after suppurative appendicitis, show that the mucous membrane of this organ is destitute of feeling for pressure, the potential or actual cautery. In Case 16 some observations were made as to sensation for heat and cold, but with a negative result.

CASE 16.—A. K., aged 34, No. 365 B., 1900. Cæcal fistula with prolapse of the mucous membrane.

December 13th, 1900. Firm pressure with a probe upon the prominent mucous membrane and pinching of the same between the finger and a metal rod, as well as the introduction of this rod far up into the ascending colon, was not perceived either as touch or pain.

Contact with hot and cold metal which produced decided effects upon the skin caused no sensation on the mucous membrane.

Ag. nit. and actual cautery, *idem*.

Granulating spot in abdominal wall, *idem*.

The same observation on the same patient except as to thermal impressions, had been made in November with the same result.

CASE 17.—F. E., aged 19, No. 641 B., 1900. The same condition, the same results.

TUBERCULOSIS OF THE PERITONEUM AND SIGMOID FLEXURE: ADHESIONS. FLUSHING OF THE ABDOMEN.

CASE 18.—A. V., unmarried, aged 40, No. 375 A., 1900. This patient had been operated on by me at the beginning of the year for ch. appendicitis, and also for an adherent ulcer in the lesser curvature of the stomach near the pylorus. She was well for six months after this, but was then admitted on the medical side for chronic obstruction and ultimately transferred to the surgical side. She had then tuberculous peritonitis, which had produced such trouble in the pelvis that an artificial anus was made in the S. flexure.

The patient was very nervous. She had in addition to the trouble mentioned all the symptoms of Basedow's disease in a minor degree. She stated that she would not have local anæsthesia, because the adjacent patients told her she would feel pain unless she was narcotised. She was satisfied however when told that general anæsthesia should be employed as soon as she felt any pain. As I passed a few hours after the operation through the ward she called out to me in her usual exalted manner, casting a reproachful glance at her fellow-patients, "Well, that was by no means so bad. If I had known that it was such a small matter, I should have said nothing." The next day in opening the S. flexure, I placed myself so that she could not see me while I was dividing the gut with the cautery. She was quite preoccupied in a conversation which was going on with one of the students, and made no remark except to say, "What is that horrid smell?" By this time the bowel had been burned through, and flatus had begun to pass.

On December 12th, $\frac{3}{4}$ cgr. morphia before the new operation, which was also done under Schleich's infiltration.

The abdominal incision opened the cavity of the peritoneum just to the left of the middle line. Under frequent use of Schleich's solution No. 2, diluted four times, the peritoneum was reached without the slightest pain.

The division of the parietal peritoneum was also accomplished without pain, the solution having been successfully injected between it and the transversalis fascia, producing the typical œdema of the subserosa.

It was now seen that the peritoneal cavity at this spot was closed by adhesions between the parietal layer and the very thin omentum, which showed hardly any fat, as well as with the S. flexure in the upper part of the wound and the small intestines below.

The sigmoid was now found to be insensitive to compression or touch, both in its empty parts and in those filled with scybala.

A piece of metal as thick as the thumb and at the

ordinary temperature of the room was placed upon the thin omentum and the sigmoid. The patient neither felt the touch nor the cold. After this a similar rod taken out of hot water, and which caused a marked sensation of heat on the skin, was applied to the omentum and sigmoid without producing any sensation of heat.

Pulling, cutting and blunt dissection of adhesions between the omentum and intestines as well as between the latter themselves, was neither felt as pain nor touch.

After division of most of the adhesions, the general cavity of the peritoneum was reached, in which several litres of effusion were found and evacuated. The fingers introduced now felt numerous small nodules everywhere over the intestines and parietal peritoneum.

This parietal peritoneum appeared to be less sensitive to stretching and pressure with the finger than is usual with the healthy membrane. But lively pain was produced when it was dragged upon or an attempt was made to separate the adhesions between the intestine and the *anterior abdominal wall*.

The withdrawal of the intestines through the wound was not perceived.

Compression of a stretched coil of small intestine covered with nodules of tubercle produced no pain.

Traction of the mesentery of the small bowel forwards produced severe pain.

As far as could be seen the most essential cause of obstruction was the adhesions between the S. flexure and the peritoneum of the anterior abdominal wall. To divide these a general anæsthetic was necessary, and consisted in just enough ether to lull the patient to unconsciousness.

As soon as these adhesions had been cut the ether was stopped, and the cavity of the peritoneum was washed out with normal saline solution at 42° C. without any discomfort to the patient.

But as soon as it was necessary to stitch the parietal peritoneum general anæsthesia was again called for (ether). The wound was closed with three rows of buried catgut,

with silk-worm gut in the skin. In the upper part of the wound was the S. flexure protruding.

On the following day the sensibility of the latter was investigated in its reddened condition. The opening of the protruded loop with the cautery was neither felt as touch or pain.

Contact of the mucous membrane or serosa of the gut with cold or warm metal or with ag. nit. produced no sensation to either temperature or pain.

Now and again the patient was severely griped when no manipulation was taking place. At such moments the bowel was seen to contract, the pain disappearing with the cessation of the contractions. This appeared to me to be due to traction on the parietal peritoneum through adhesions with the intestines and the sutures of the S. flexure with the abdominal wall.

It appears then that the conditions as to sensation are the same in the tuberculous as in the healthy peritoneum, the omentum, the bowel, and adhesions between these parts. They are insensitive to all operative manipulations. The omentum and S. flexure are without feeling for warmth or cold; the peritoneum parietale is on the other hand very sensitive, but not more so (apparently less) than in health. Flushing the abdomen with normal saline solution at 42° C. produces no discomfort.

UTERUS AND ADNEXA.

In a case of hypertrophy of the vaginal portion of the cervix in which a wedge-shaped piece was to be excised, some observations were made on sensibility while cleansing the vagina and seat of operation just before anæsthesia was induced. The cervix was steadied between two speculæ, one anterior and one posterior. Then with a pointed cautery eight punctures were made deeply into the lips of the os uteri which were to be excised. Further both lips were seized with tenaculum forceps, completely transfixing both structures. In this case neither the

cautery nor forceps produced any sensation of pain or contact so long as all pressure or traction upon the vaginal portion could be avoided. When this could not be done the patient stated frankly that she felt either pressure, dragging, or slight pain. In another case in which I used the actual cautery upon the portio-vaginalis without anæsthesia the same was found. Surgeons who frequently perform excision of the uterine mucosa without anæsthesia assure us that this is not a painful operation. It is hard, however, to come to a definite conclusion upon this point from scraping or sounding of the uterus because these procedures cannot be carried out without fixation, depression, or stretching of the uterus, which must always be associated with traction of the attachments of the adnexa to the abdominal wall. I have myself endeavoured to ascertain how far this organ is insensitive to the metal sound, and have noticed that the instrument was only felt at the moment of passing the os, or, in other words, while the organ was being stretched.

Further, during a laparotomy occasion was taken to test the sensibility of the fundus uteri, the left ovary and tube, and it was found that all were insensitive to the actual cautery.

CASE 19.—A woman, age 32, March 11th, 1901. Abdominal hysterectomy for cancer. Local infiltration for the skin and abd. wall, and then general anæsthesia. As soon as the uterus, adnexa, and the intestines had been packed round with gauze dipped in normal saline solution the anæsthesia was stopped. Then the right broad ligament and adnexa were dissected without pain from the abdominal wall, during which the patient gradually woke up. The following observation was now made. Burning of the left part of the fundus close to the tube and round ligament with the actual cautery, of the left ovary and tube with the uterus and the corresponding median part of the *ala vespertilionis*, all painless, although the slightest touch with the cautery upon the skin was enough to provoke an exclamation. As I then attempted to stretch

the left broad ligament in order to dissect it from the abdominal wall pain was felt, and general anæsthesia was at once resumed.

In another case of large abdominal tumour which I took to be a carcinoma of the ovary, I made an exploratory incision under local anæsthesia. In order to control a bleeding point the cautery was applied firmly to the anterior surface of the tumour and an eschar produced over a small area, the patient being quite free from all sensation in the part. But when I saw that the tumour had contracted adhesions in all directions, ether was administered for its extirpation.

But because a cancerous mass in the ovary possesses no sensory nerves in one part of its periphery it would be obviously incorrect to conclude that the ovary itself is destitute of such nerves. It is possible to believe that tumours possess no other nerves than those necessary for their nutrition. Last autumn I extirpated a sarcoma as large as the fist which had started from the lower part of the lobe of the ear, probably from the spot pierced for an earring. In this tumour no sensation was felt either to mechanical, chemical, or thermal stimuli. The same may be said of two other large tumours, a lipoma of the neck and an enchondroma of the back.

This appears to harmonise with some statements made by O. Bloch* in his clinical notes in regard to seven ovariectomies and three myomectomies under æthyl chloride after primary chloroform narcosis. Here incisions into the tumours and ligation of their pedicles appeared to produce no pain. In two cases the ovaries were caught in forceps without any expression of pain from the patient. But all Bloch's patients were to a certain extent under the influence of chloroform.

That Veit was able to do a conservative Cæsarean section "with the best results" under local anæsthesia speaks also for the fact that the uterus is insensitive to

* "Om Inskrænkning i Anvendelse af general Anæstetisering," *Bibliot. f. Læger*, 1898.

incision. I have already pointed out that Veit does not compress the collum uteri, and completes the whole operation without protruding the organ from the abdomen. If, as I believe, the whole uterus is without sensation, Veit's operation would only be associated with pain originating in the abdominal wall, or possibly from its own contractions, causing strain on the attachments of the organ to the tissues of the pelvis.

THE KIDNEYS.

Case 20 shows that a kidney whose fibrous capsule had been separated from the surrounding fat was quite without any feeling for heat or cold in the outer part of its cortex and its lateral border. That does not prove, of course, that a normal kidney in its usual place must have no feeling, at least in its fibrous capsule, which possibly possesses nerves common to it and its fatty capsule. Bloch* believes that the kidneys possess but little sensation, and Schleich that the parenchyma is insensible.

CASE 20.—P. P., aged 59, No. 666 B., 1900.

Diagnosis.—Bladder tumour and suppurative cystitis and pyelonephritis with paranephritic abscesses containing staph. aureus.

November 20th, 1900. Peritoneal incision with drainage of the bladder, and also nephrostomy after opening up of the paranephritic abscesses and separation of the whole kidney from its fatty capsule.

Tests of sensibility on December 13th. The kidney was lying in an oblique incision in such a way that its convex border could be seen and the incision in its pelvis.

Contact of the surface with cold and warm metal, highly sensitive to the skin, was not felt as different in temperature.

Neither light scarification of the cortex nor a deep

* Oscar Bloch, *Nord. med. ark.*, 1899.

transverse cut through an abscess the size of a nut in the cortex was perceived in any way either as touch or pain. The same may be said of application of silver nitrate.

In dressing three other nephrostomies I made the same observations with the same results as regards the parenchyma. But when the inner aspect of the renal pelvis is touched with a probe an unpleasant sensation of pain is complained of.

The cases now to be recorded during part of the procedure were all operated on under general anæsthesia, that is, until the viscera had been arranged for the specific aim in view.

EXAMPLE AS REGARDS THE ANÆSTHESIA. ACUTE
STREPTOCOCCUS PERITONITIS.

CASE 21.—Laparotomy under morphia, infiltration by Schleich's method and ether. December 18th, 1900.

K. E. A., aged 44, No. 318 A., 1900.

Diagnosis.—Acute gangrenous appendicitis (v.a. not perforated). Diffuse peritonitis. This was of the dry, thoroughly diffuse streptococcus form between the small coils, without fluid exudation or lymph-flakes. The serosa of the anterior wall of the abdomen appeared healthy. The loaded omentum lay over the cæcum and the small intestines, and had protected the anterior parietal peritoneum.

The abdomen was opened under infiltration anæsthesia. The division of the parietal peritoneum produced neither more or less pain than in other cases.

It was necessary now to employ general anæsthesia in dealing with the intestines, and the appendix was separated from the pelvis, in which it was firmly adherent, and brought into the wound. Then the general anæsthesia was stopped, 30 cm. of ether having been used up.

While the patient now lay half asleep the appendix was cut off close to the cæcum with the actual cautery, where it was sound to all appearance. To invaginate the

stump of the process two "tobacco-pouch" sutures were employed. A ligature of the mesenterium *en masse* slipped, and four artery forceps were applied. The half sleep still continuing, a rectal tube was introduced, the transverse colon punctured, and the S. flexure compressed to facilitate the evacuation of the fæces and gas, and to render possible the reposition of the coils. Besides this 8 ccm. of mag. sulph. solution (50 per cent.) was injected into the bowel. All this evoked from the patient no expression of pain.

For the removal of the gauze packing and the stitching of part of the wound, general anæsthesia was again employed, 45 ccm. of ether being used.

At the beginning of the operation the patient had had $\frac{3}{4}$ cgr. morphia.

On December 19th a fistula was made in a coil of small intestine left in the wound.

"A 'tobacco-pouch' suture was placed in a ring as large as a two-shilling bit in the serosa of the bowel, and the latter was opened with the actual cautery; after this the suture was closed over a drain tube. All this caused no pain or sense of touch." (Haglund.)

The patient died of septicæmia. In the blood of the heart streptococci were found. The peritoneal cavity was absolutely dry.

An acutely inflamed intestine then appears as little sensitive as a healthy one.

FURTHER EXAMPLE AS REGARDS ANÆSTHESIA : STOMACH.
JEJUNUM. TRANSVERSE MESOCOLON. THERMAL
SENSATION.

CASE 22.—Laparotomy under infiltration, morphia and ether.

Anna E., aged 42. No. 374 A., 1900.

Diagnosis: Pyloric cancer. Operation, December 12th.
Retrocolic gastro-enterostomy with entero-anastomosis.

The belly was opened in the same way as Case 17 without any clear evidence of pain.

Incision through the rectus sheath, and peritoneum parietale caused no pain because a real infiltration had been produced. Before the peritoneum was opened $\frac{3}{4}$ cgr. of morphia was given subcutaneously.

To reach the stomach, the colon and omentum were drawn down, but even a gentle traction on these parts produced pain, and general anæsthesia was at once induced, about 30 ccm. of ether being used.

The stomach lying high the incision was prolonged upwards and the organ was drawn forwards. A pyloric tumour was then found movable, but surrounded by infected glands.

When the stomach had been pulled forwards and packed round with gauze wrung out of normal saline solution and the small intestine had been likewise protected the general anæsthesia was stopped. Immediately upon this the patient opened her eyes and answered questions.

Without any pain the jejunum was now examined and an opening made in the mesocolon through which the stomach was drawn, fixed with two Doyen's forceps and connected with the jejunum, similarly clamped, by an opening 6 to 7 cm. long. The patient on being asked said that she did not even feel a touch in these parts.

The openings in both stomach and bowel were made with the actual cautery, any bleeding vessels being closed with forceps. Two rows of sutures were used posteriorly and three rows anteriorly round the opening. The mucous membrane of the stomach was red and swollen.

A 3 cm. anastomosis was now made between the afferent and efferent loops of the jejunum and the latter was opened with the cautery sutured as above. The bowel had been clamped before. This part of the operation was also painless and without tactile sensation. The same may be said of the removal of the gauze from among the intestines where it was *not* in contact with the parietal peritoneum.

Thermal sense was also tested by ice wrapped in gutta-percha tissue, and hot metal, with a negative result.

The opening in the mesocolon was also stitched without any evidence of pain.

On attempting to remove the gauze in contact with the parietal peritoneum pain was felt and general anæsthesia was again induced, which was kept up until the abdomen was closed by stitches.

There was no nausea or other disturbance after the operation. The patient drank afterwards hot water, and later Vichy water and milk. The next forenoon she had two cups of gruel, and on the third day a lightly-cooked egg and bits of meat.

STOMACH. JEJUNUM. PARIETAL PERITONEUM IN FRONT
OF THE SPINE. THERMAL SENSIBILITY.

CASE 23.—J. P., No. 382 A., 1900.

Pyloric carcinoma. December 29th, Gastro-enterostomia, retrocolica-anterior with entero-anastomosis.

On injection with Schleich's solution the patient began to complain, and at the first cut became so restless that ether anæsthesia was begun and $\frac{3}{4}$ cgr. of morphia were injected.

Then the abdomen was opened and a large tumour was found in the pyloric part, surrounded by hard infected glands.

As it was difficult to find an avascular spot in the mesocolon an opening was first made in the gastro-colic ligament in order to better control the division of the mesentery and the passage of the bowel through it. The posterior wall of the stomach was then seen to be widely infiltrated with cancer stretching far to the left. It was therefore decided to perform an *anterior* retro-colic gastro-enterostomy, to which end a loop of the jejunum was drawn through the mesenteric opening and then through the gastro-colic omentum and laid across the anterior wall of the stomach, which had been drawn down and sur-

rounded by gauze damped with normal saline solution. When all was in order for the suture of the two viscera the anæsthesia was stopped, about 80 ccm. of ether having been used.

The anastomosis was then completed by two rows of silk sutures posteriorly and three anteriorly. The openings were made partly by the actual cautery and partly by scissors. An anastomosis was also made between the afferent and efferent loops of the bowel.

During this part of the operation the patient was quite conscious and felt nothing.

Some observations were now made while the patient was fully conscious.

First as regards the posterior parietal peritoneum. A finger passed between the intestines and pressed upon the posterior abdominal wall partly to the right of the aorta (? fourth lumbar vertebra) and partly on the promontory, was neither felt as touch or pain. But as soon as the finger was brought in the least in contact with the abdominal wound, the patient announced that he felt the touch. Considerable traction on the mesentery of the small intestine, probably its central portion, was not felt.

As regards thermal sensation in the stomach, cold and warm metal and ice wrapped in sterile gutta-percha paper produced no sensation of touch, cold or warmth. The same on the skin were at once differentiated.

As regards the small bowel, tight stretching between the fingers in any direction was not felt. The removal of a piece of gauze which lay between the coil behind the anastomosis of the bowel was not noticed by the patient.

An attempt now to remove the gauze which lay between the intestines and the parietal peritoneum caused such severe pain that general anæsthesia was again induced. Under this the gauze was removed, the stomach and the intestines replaced, and the wound stitched. For this 55 ccm. of ether were used.

Cases 22 and 23 show *that the posterior and anterior walls of the stomach about the greater curvature are as in-*

sensitive to operation as we have seen the small intestine, the cæcum and the S. flexure to be. The same is true of the part of the mesocolon usually selected for retrocolic gastro-enterostomy.

It is also clear that the stomach does not react to heat or cold. This agrees with Weber's* observations upon himself. I too have experimented in the same way upon myself with my morning beverage. I have drunk it as hot as possible and fancy that I have felt an immediate sensation of warmth in the epigastrium. This was, however, so superficial that I believe it to have been due to sensation in the skin of the anterior abdominal wall. On the other hand I could not recognise any sensation of warmth towards the back. In the test for thermal sensation in the parietal peritoneum (Case 24), the patient had no sense for touch, warmth or cold, to metals or ice. But if the metal was very hot she said it pricked, which must be interpreted as a sense of pain. I would not venture, however, on the strength of this single negative observation to dogmatise in regard to the thermal sensation of the parietal peritoneum. But if further observation demonstrates its absence, we may take it that draughts of hot fluid only produce a "sense of warmth in the stomach" when the wall of the organ and the abdominal parieties are warmed through as far as the subcutaneous areolar tissue or skin itself.

A very interesting observation was made in Case 22, which, however, calls for further confirmation. The posterior parietal peritoneum showed itself insensible over the fourth (?) lumbar vertebra and promontory. It was also highly remarkable that no pain was complained of when the portion of the mesentery of the ileum was drawn forward which was believed to belong to its middle. I have very carefully pondered this point, and have arrived at the hypothesis that the p. peritoneum over the fourth and fifth lumbar vertebræ between the two trunks of the

* *Vide* p. 17.

sympathetic and between the two inner borders of the psoas muscles possesses no nerves for painful impression. If this is true, it would also hold for the peritoneum over the sacrum between the trunks of the sympathetic. My hypothesis is based upon the fact that anatomists have not succeeded in demonstrating that the parts of the peritoneum in question receive any other nerves than from the sympathetic. And if the peritoneum over the fourth and fifth lumbar vertebræ is without sensation we ought to be able to stretch a small part of the mesentery of the small intestine without producing pain.

That the upper part of the stomach is just as insensible to stimuli as that near the greater curvature is shown by a case operated on by Dr. Olsson, which I am permitted to publish. But we also learn from it that traction of the cardiac portion of the stomach and of the duodenum, *i.e.*, of the diaphragm and subserous connective tissue, produces severe pain.

A woman, aged 56, was operated on for a large movable tumour on April 13th, 1901. The patient was extremely feeble, but desired pylorotomy. The abdominal wound was made under infiltration anæsthesia. The tumour was quite movable and no glands were seen to be affected except those close along the smaller curvature, in the lesser omentum. The drawing forward of the stomach caused such suffering that the patient was put lightly under chloroform and ether. During the ligation of the gastro-colic ligament and lesser omentum, the patient became gradually conscious and was fully so as the forceps were closed upon the stomach. Neither this nor the cutting off of the stomach or its suture was felt. The tumour reached high up on the lesser curvature, and as it was necessary before putting in the sutures to draw down this part further the patient complained very much. The same was the case as the duodenum was drawn forwards for union with the stomach by Kocher's method. In both instances it was clearly the traction which caused pain. The patient was discharged well on May 9th.

SEROSA OF THE BLADDER. HAS THE PARIETAL PERITONEUM THERMAL SENSATION? CONFIRMATION OF THE FOREGOING OBSERVATIONS IN RESPECT OF THE SENSIBILITY OF THE ABDOMINAL CAVITY.

CASE 24.—The same patient as in Case 15, aged 34. She was admitted in June, 1900, having suffered for a week before from epityphlitis. I at once evacuated a large collection of effusion through the posterior fornix vaginae. Later through long incisions parallel to Poupart and the iliac crests on both sides, no less than eight more or less communicating collections of matter in both iliac fossae and in the more central part of the abdomen as far as the navel, were opened. The patient was for a long time very ill with albuminuria and fistulae in the intestines. In October one of the fistulae remained in the left groin, but an operation under general anaesthesia showed that it did not communicate with the intestine. At the same time two holes were found in the caecum and a fistula in the small bowel. The first were closed by suture, the last could not be dealt with. The ether was badly borne; she had a very rapid pulse, and for three days I feared that she would collapse and die.

After some time a large opening again formed in the caecum through which all the motions passed. In December, following Cushing,* I fed her for a while on sterile food and then performed an ileocolostomy with complete exclusion of the affected caecum, after Salzer and v. Eiselsberg's methods.

December, 1900.—Operation. Under local anaesthesia by infiltration with Schleich's solution No. 2, diluted four times, the abdomen was opened through the right rectus sheath, the median border of the muscle being pulled outwards. A large number of adhesions were found between the ileum, parietal peritoneum, bladder, S. flexure, uterus and adnexa, ascending colon and caecum.

* Compare my article, *Upsala läkerenfören förhandl.*, 1900-1901. *Deutsch Zeitsch. für Chir.*, March, 1902.

It was necessary to divide the skin and muscle transversely at the level of the navel.

In the lower part of the ileum was found a small fistula between two coils which contained fæces. The lower 40 or 50 cm. of the ileum in which this fistula lay were so damaged that it was deemed advisable to completely exclude them from the intestinal circulation. In the iliac mesentery were many swollen glands, none larger than a bean. A 7 cm. ileocolostomy was made about 50 cm. above the ileocæcal valve and in the colon to the right of the gall bladder.

The ileum and colon were divided by Doyen's method and each of the four ends stitched separately.

The union was made so that the peristalsis of both intestines should correspond.

The omentum was spread over the anastomosis and the two ends of the colon. The mesentery and intestines near the anastomosis were fixed by stitches so that there should be no opportunity of internal strangulation in the opening. The old scar in the groin was opened for drainage and Douglas's pouch was drained with a tube and gauze. The cæcal fistulæ were left open and kept so with a tube. The new abdominal wound was closed with three rows of buried catgut and the skin with silkworm gut knotted later.

N.B.—It is better to divide the colon more towards the left than in this case. The mesentery is here longer and more mobile, and the ends can be better closed than at the hepatic flexure, where under normal conditions there is no free mesentery.

The opening of the abdomen through the right rectus sheath was made under local anæsthesia and remained painless until the parietal peritoneum was reached. Here, with the exception of small areas which were rendered quite œdematous by the injected fluid, the patient suffered pain for some few minutes. But it was noted that the mesial border of the incision was without feeling. The nerves had been divided in the incision which lay $1\frac{1}{2}$ to 2 cm. to the right of the linea alba.

In the following part of the operation general anæsthesia (ether) was only employed when the parietal peritoneum was handled directly or indirectly. The duration of the operation extended over three hours and the amount of ether used was 220 cm.

During the procedure the patient had $\frac{3}{4}$ cgr. of morphia in two doses towards the beginning and the end.

(1) The sensibility was as follows:—Nothing was felt in the manipulations of the colon and small bowel or in the mesentery or omentum major, provided that they were limited to these organs without traction on their attachments to the posterior wall of the abdomen.

(2) All operative measures could always be taken without pain on the adhesions between these bowels, between bowel and omentum, and bladder, &c., *i.e.*, on all adhesions which did not directly affect the parietal peritoneum.

(3) Operations on the parietal peritoneum as well as on adhesions between the latter and the bowels were more or less painful.

The greatest pain appeared to be produced by *traction* on the p. peritoneum. In extirpation of adhesions to the latter it is always stretched to some extent. It is possible that this pain is due to stretching of the nerves of the serosa parietalis.

Notes on the thermal sense were also made on the parietal peritoneum. Cold and warm metals sensible to the skin were not felt by this structure nor was ice felt. A hot metal produced pricking sensation.

The serosa of the bladder is lacking in tactile, painful and thermal sensation; but the sense of pain was only tested with a warm piece of metal.

The patient bore this tedious operation very well. She showed no sign of collapse and took nourishment on the evening of the operation day. Recovery was perfect up to December, 1901. I have done several similar operations in the course of 1901 and gained from them precisely the same impressions as to the sensibility of the abdominal cavity, without, however, having made special investigations and notes thereof.

THE SENSIBILITY OF DISEASED INTESTINE.

It is generally supposed that diseased intestine perceives painful impressions, and that this is particularly true in acute inflammation. In this communication, however, are many instances of chronic and acute inflammation of the intestines quite insensible to operation. For instance, Case 1, where the jejunum was very hyperæmic and distended owing to acute stoppage; Case 21 with acute streptococcus inflammation; Cases 11 to 15a, where we had to do with more or less inflamed vermiform appendices. Besides these there were three cases of diseased gall bladder (5·7 and 8) all quite insensible to operation.*

In reference to the formation of ulcers in the intestines it is well known that when uncomplicated they are as a rule painless whether tubercular, syphilitic, or typhoid†; of ulcer in the stomach we know that no pain may be present up to the moment of perforation into the peritoneal cavity in some cases of latent disease.

The question whether acutely inflamed bowel has any feeling will be soon definitively answered now that many surgeons operate on gangrenous hernia under local anæsthesia. All are probably agreed that between the gangrenous and the healthy portion of the afferent loop there is a part which may be called acutely inflamed. Should it be shown that this portion is possessed of sensation, the question will be settled in favour of the present view. For my part, I regard the problem as already solved and am convinced that acutely inflamed intestine is as insensitive as healthy. I have lately performed four resections of intestine for gangrenous hernia or internal strangulation. In these I found that the afferent limb in all four was absolutely without feeling during the operation (comp. Hofmeister's view already quoted). I have also lately operated on a man seven and a half

* In two other cases of cholecystitis since operated on I have found complete insensibility of the gall bladder.

† *Vide* Cushing's views in the "Literature."

hours after perforation of the stomach. The perforation, which was at least 2 cm. long, lay in the middle of a large tumour, either a cancer or an ordinary ulcer of the pylorus, at the lesser curvature. I covered the hole with omentum and performed retrocolic anterior gastro-enterostomy with entero-anastomosis. The walls of the stomach and intestine, swollen by inflammation, were absolutely without sensation during the operation. When, four days later, I removed the tampons which filled the large wound reaching from the ensiform to the symphysis and also across one of the recti muscles, no pain was felt when the gauze was pulled off the intestines, mesentery, stomach, and omentum, so long as I avoided any traction on the abdominal wall.

From Buch's work (*vide* "Literature") we see that many distinguished investigators have observed that when the ganglia and trunks of the sympathetic are exposed to the air, or when they are firmly pressed upon, they become sensitive, but that freshly dissected ganglia and trunks are quite insensitive. These experiments on animals cannot, of course, be controlled by similar observations on man, but it is quite certain that they do not hold for the sympathetic nerves coursing in the human intestines. In our Klinik in Upsala during the winter 1900-1901 a considerable number of cases have been operated on in which it has been necessary for one reason or another, usually peritonitis, to pack more or less of the peritoneum with gauze. In several of these cases there were also intestinal fistulæ. Here either shortly after the operations or later when the serosa was granulating I have made observations, during the dressings or other manipulations, on pain, touch, and thermal sensation, and always found that the exposed surfaces of the inflamed intestine were absolutely without feeling whether to the cautery or silver nitrate, hydrochloric acid, solid chromic acid, or squeezing with Péan's forceps.

That the sympathetic nerves in the intestine are not rendered sensitive by pressure is seen in those cases in

which an artificial anus is made in two stages, or where one or both ends of the intestine are closed for a day or so by forceps. Moreover, if pressure rendered the intestinal nerves sensible to pain, the latter ought to be present when Dupuytren's enterotome is employed. But when the instrument is properly used and supported by dressings this is not the case, as is well known. When, however, it is so applied that traction on the parietal peritoneum is made, pain is felt.

As I have said the conviction is forced upon me that diseases of the intestine and generally of the other viscera of the abdomen are painless in themselves so long as they lead to no mechanical or inflammatory irritation, toxic or infectious, of the intercostal or sacral nerves running under the parietal serosa. We may also imagine a chemical irritation perhaps. Thus the unpleasant sensation felt by those troubled by acid dyspepsia may possibly be due to the absorption by the diaphragmatic lymphatics of a hyper-acid gastric fluid acting upon the sensory nerves adjacent.

According to my view it is easy to comprehend that adhesions to the parietal peritoneum may give rise to pain, and that this is present in greater severity where the union is cord- or band-like, than when short or attached to a wide surface of intestine.

Of the pains which are associated with stenosis of the intestine, it may be fairly said that they belong to the most severe from which the human being can suffer. If my views upon this whole question be correct any painful stenosis of the bowel without adhesion to the parietal peritoneum and unassociated with any lymphangitis or lymphadenitis extending to the parietal subserosa, can only excite pain on the one hand by general stretching of the parietal peritoneum as it takes up more room, or on the other by pulling upon the root of the mesentery owing to its entanglement with other coils. When the retroperitoneal duodenum is dilated pain must be produced by stretching of the intercostal and lumbar sensory nerves of the neighbourhood. And a stenosis of, for instance, the

S. flexure or colon descendens must be accompanied by pain as soon as there is any powerful contraction or distension of the proximal gut. That such a line of thought may at times help us to a correct diagnosis, the following case shows. A business man, somewhat over 50, complained of pain in the region of the breast for about a year, but of late so severe that he attributed it to his heart, and feared that he would die in one of the attacks. Having heard his description I asked him had he any difficulty with his motions. He then stated that for more than a year every stool was accompanied by pain at the anus and at times by bleeding. An examination of the anus disclosed a deep fissure with very hard edges. Nothing abnormal was found in either the heart, lungs, or kidneys. A four days' course of enemata and laxatives brought away an unheard of amount of fæces. Subsequently, the hardness and fissure were excised and proved to be carcinomatous. During the whole time that the patient was under observation after this he had not a single attack of the old pain in the breast, and was soon convinced that his heart was sound and that he had been suffering from colic.

To avoid repetition on this point I refer the reader to my article in *Centralb. für Chir.*

ON NARCOSIS.

From these experiences I venture to recommend for those patients for whom ether or chloroform alone is unsuitable, a combination of morphia subcutaneously with Schleich's infiltration of the skin, areolar tissue and rectus sheath, together with ether or chloroform if called for. The latter are employed for the division of the peritoneum and when the viscera have to be replaced, *e.g.*, a resection. But whenever the operator does not come directly or indirectly in contact with the parietal serosa they are not necessary. The removal of packing, arrangement of the gut and stitching of the peritoneum call for light general anæsthesia again. Lately I have often employed instead of infiltration, a mixture of æthylchloride and methyl-

chloride (= anæsthile) for the skin and areolar tissue. We always try to operate under "primary" ether narcosis (comp. *Sudek Centralb. f. Chir.*).

In cases of inguinal hernia I prefer Cushing's method. I have already shown that absolute loss of feeling is never attained, but most of our patients have assured me that "the pain was not worth mentioning" as compared with the nausea of their fellow-patients after general anæsthesia.

By this combination of infiltration of the skin and areolar tissue with injection of the inguinal nerves, one can operate without risk upon old people with damaged vessels, bronchitis and emphysema, in whom hernia operations are so often followed by pneumonia when general anæsthesia is employed for long.

But crural herniæ can be very well dealt with under infiltration alone (comp. my article in *Centralb. f. Chir.*).

When operating for hernia we ought to cultivate rapid manipulation and the technique of local anæsthesia ought to be practised by all employing it.

TRACHEA. PLEURA.

Here follows an observation upon the sensibility of the anterior wall of the trachea and its mucous membrane and of the *pleura pulmonalis*.

A widow, aged 67, of placid disposition, suffering from cyanosis owing to a large enchondroma of the larynx, underwent at my hands a tracheotomy after injection of cocaine in the skin and subcutaneous areolar tissue. This patient stated positively that she suffered no pain when sharp hooks were inserted in the trachea and an incision was made between them in the tube.

A painter, aged over 30, was operated on for septic empyema. I infiltrated the skin, &c., and injected the intercostal nerves lying under the lower border of the rib to be resected. The operation was far from being painless, but the patient, who shortly before had had general anæsthesia, declared soon after that he was very thankful to be spared a repetition of it. I see in the notes of this case

that scraping of the almost healthy pleura pulmonalis with an instrument was not felt either as touch or pain, in other words, this structure was insensitive.

The obvious cause why the resection of the bone in this case was not painless was that the tissues around each rib are innervated both from the intercostal nerve below it and the one above, probably mostly from the latter. Having lately to operate on a left empyema in a feeble old drunkard I proceeded as follows:—After infiltration I was able to reach the ninth and tenth intercostal nerves behind the angles without pain. On the tenth I dropped a little 5 per cent. carbolic solution, and it was then divided without pain. Into the ninth I injected $\frac{1}{2}$ per cent. cocaine solution. It was then possible to resect 6 cm. of the tenth rib just anterior to the angle without pain. The very much thickened pleura costalis was also divided without pain. After the escape of the thick yellow pus and fibrinous clots it was seen that the lining was adherent to the diaphragm. The pleura pulmonalis had a perfectly normal appearance. There was no sense of pain when a metal sound taken out of boiling water was introduced along the lateral border of the lung. The lower border of the parietal wound in its deeper layers was also absolutely insensitive, as I have since seen in another case as well.

Garre,* who has had such a large experience in operations on the lungs, says: "Where the operation is done in two stages no anæsthetic is required for pneumotomy; the tissue of the lung is in itself insensitive." This harmonises with the old clinical experience that pleurisy is painful, but central pneumonia and chronic lung troubles unaccompanied by pleurisy are painless.

In a word, I believe that the lungs like the abdominal viscera are painless to operative measures, while the parietal pleura and peritoneum are sensitive.

It strikes me as though all those organs supplied by the sympathetic alone or by the vagus after it has given off

* "Die chir. Behandl. d. Lungenkrankheiten," *Mitth. a. d. Grenzgeb. d. Med. u. Chir.*, Bd. ix., 1902, p. 327.

the recurrent, such as the lungs, and most of the abdominal viscera, the brain, and the thyroid body, are insensitive to operations.

Ever since I saw Kocher and Roux in 1892 entirpating the thyroid after infiltrations of the skin and areolar tissues I have like many other surgeons followed the same practice. In watching these patients during the operation one soon arrives at the conclusion that the thyroid body is possessed of very little sensation, and in the case of a woman, aged 41, whose temperament was very placid, I made some observations specially directed to this point (No. 645 B., 1901). It was a case of a large goitre with multiple adenomata. Here after infiltration I made Kocher's "collar cut" (Kragenschnitt) and then enucleated the right, the middle, and the upper part of the left lobe. The lower part of the latter was comparatively healthy and was left intact. As soon as the tumour was laid bare I do not think the patient felt any more pain unless when the surrounding parts were pulled upon. On what remained of the left lobe I made observations with mechanical, chemical (nit. acid, chloroform) and thermal stimuli, but the organ showed itself quite without sensation. Primary union followed. The normal thyroid was also found in a case of attempted suicide to be insensitive to clamping with forceps.

In considering abdominal pain it is interesting to reflect upon those cases of operations upon the vermiform appendix in which the pain was referred to or around the navel, and on the hernia operations where it was felt in the urethra. In addition to the above I have had another case of a woman who felt pain during an operation upon a crural hernia, also chiefly in the urethra.

RECTUM.

The following note upon the sensibility of the rectum, made in September, 1901, also deserves to be here recorded.

M., Danish governess, aged 47, was operated on at Copenhagen, in 1899, for tubercle of the rectum, for which

5 to 6 cm. of the bowel together with the left half of the anus were removed. In the autumn she was sent to the Klinik in Upsala with a view to seeing if I could remedy her complete incontinence of fæces by my plastic operation.* The anus gaped widely and the m. membrane of the anterior wall of the bowel was prominent and projected more and more when the patient strained. On examination with bits of paper, with probes and the point of a pin and faradic current, it was seen that the m. membrane was absolutely insensitive to touch or pain. The skin on the other hand was fully sensitive. The bounding line between the two structures was quite sharply defined by the junction between them. The mucous membrane was also without feeling for 5 per cent. acetic acid and 5 per cent. nitric acid. The part was also tested for thermal sensation with tubes filled with water at various temperatures and with metal from ice-cold water. The results were negative both as regards touch and temperature.

The question then arises whether in such a rectum the presence of fæces can make itself felt and give warning when it should be emptied.

To settle this point, and to see what amount of distension of the bowel is necessary to induce a desire to defæcate, thin rubber tubes of varying length attached to a glass tube were inserted, through which water was gradually pumped until the patient felt a desire to go to stool. From this was seen that the distension of the rubber tube necessary to produce straining, no matter what its length, was the same; also that the dilatation of the rubber tube amounted to 3.5 to 4 cm. in diameter; the longest was 10 to 11 cm., the shortest, 4 cm. The call to defæcate appears then to come as soon as the lower part of the rectum has reached a certain stage of dilatation, which in this case was $3\frac{1}{2}$ to 4 cm.

Similar observations were made in another earlier case operated on by me. (*Vide* Case 3. *Upsala läkarefören förhandl.*, N.F., Bd. 5.)

* *Upsala läkarefören*, N. F., Bd. iv. and v.; *Centralb. f. Chir.*, 1899, p. 722; *Brit. Med. Journ.*, 1900, vol. ii.

TESTICLE.

The scrotal skin and various tissues of the testicle are very sensitive. They receive their nerve supply from the external spermatic and from other twigs of the lumbar plexus as well as the pudendal nerve. What then are the conditions of sensibility in the testicle itself and the epididymis? So far, I believe, no observations have been made upon these points. We believe that the vas spermatica and vas deferens with their artery are only accompanied by sympathetic nerves. After their passage through the internal abdominal ring, they receive the addition of the so-called external spermatic nerve and of the cremaster muscle completing the spermatic cord. Sensory nerves from the external spermatic and the pudendal nerves probably pass both into the testis and the epididymis. From my own few investigations, however, it would seem as though the testis and epididymis possessed no sensation. If one considers the functions of these organs, it is hard to see why they should require to feel. It is probably enough for them that they are invested in very sensitive tunics and are enveloped in two muscles, the cremaster and dartos, which rapidly contract when the other investments are irritated. This leads to a change of place of the testis up to or near the external ring. By this mechanism many a blow or crush of the testicle is avoided. At the same time the testis is in many cases kept warmer.

CASE 1.--P. V., aged 19, No. 687 B., 1901, suffered from tubercular disease of the whole right epididymis. As this had developed very rapidly I thought it desirable to remove the epididymis completely while preserving the testis. The patient's general condition being very bad I advised him to have local anæsthesia by injection of a $\frac{1}{2}$ per cent. solution of cocaine into and under the scrotal skin. Unfortunately the amount used is not recorded in the notes, but I follow the rule never to exceed 6 grs. of this solution in such operations. The skin and dartos were divided without pain. The parietal and visceral layers of

the tunica vaginalis were adherent and were dissected from one another without pain. The testis was then drawn out of the scrotal wound and five pairs of Péan's forceps were placed on bleeding points partly in the tunica vaginalis and partly in the tunica albuginea without any sense of pain. A drop of cold sterile water on the testis and contact with warm and cold instruments was not perceived either as touch or otherwise. Neither was any discomfort felt when a glowing cautery was held close to the testis nor when it was pricked or scratched with a needle.

Very often I remove diseased portions or when necessary the whole of the epididymis with the cautery. In this case I did so. At the commencement the patient felt nothing, but as the red-hot instrument penetrated a few millimetres between the epididymis and testis, the patient began to complain of ever-increasing pain. At the same time one saw spasmodic contractions of the cremaster. Ether was then given, under which the operation was rapidly finished. Healing took place *per primam*. Three months later he was still well and the testis appeared quite normal to the touch. The patient declared that the pain which he felt was not the same sensation as that of a burn. It did not manifest itself at once when the testis was touched but only after a while.

Against this observation it can be objected with perfect justice that it proves nothing because the local anæsthesia of the cocaine injection may have penetrated into the body of the organ and the epididymis, as the two leaves of the tunica vaginalis were adherent. In the following case however, cocaine was not employed, but freezing by anæsthile. The patient had previously had 1 cgr. of morphia.

CASE 2.—A. D., aged 31, No. 68 A., 1902. Had a tubercular nodule in the cauda epididymitis. After freezing with anæsthile the skin and dartos were incised without pain, but the division of the parietal layer of the tunica vaginalis was painful and accompanied by contraction of the cremaster. In this as in the following case extremely

painful contractions of the cremaster were produced whenever the testicle was grasped between the fingers, or when a sterile cloth or other object came in contact with it. But it was impossible to determine definitely what this was excited by.

Touching of the visceral layer of the tunica vaginalis propria with the point of a needle or knife produced no pain, and contact of warm metal with the testis was not felt as warmth. In these as in the other cases control observations were so far made as to test the sensation on the patient's skin with the same stimuli which were used upon the testis. Where these did not at once give a positive result on the skin the effect on the testis is not noted.

As the cremasteric contractions were painful, the patient was put under ether and the knot in the epididymis was excised. Union took place by first intention.

CASE 3.—J. V., aged 67, No. 158 B., 1902. Large right hydrocele of t.v. Winckelmann's operation. The sac was opened under anæsthile. Pricking and scratching of the naked testicle and epididymis with a needle were not felt at all. When the testicle was touched with warm metal the patient felt no heat, but "an ache in the back." This was only felt after a few seconds or a longer time had elapsed, but it could not be determined whether it was synchronous with the cremasteric contractions. When the testis was flushed with sterile water, the patient complained of violent pain internally towards the back as he expressed himself. This point was 6 cm. to the right of the mid-line and 5 cm. below the crest of the ileum. Remembering Head's observations, the skin and soft parts over this point were tested as to the presence of possible disturbances of sensation. None could be found, however. During the stitching of the parietal layer of the sac behind the cord, the patient complained of a severe ache which he localised at the spot indicated as "a shoot."

CASE 4.—E. P., aged 64, No. 85 A., 1902. This patient had a large direct inguinal hernia and a large hydrocele

of the testis on the right side. A few weeks before he had squeezed his scrotum while riding a runaway horse. Under anæsthile the skin, areolar tissue, and aponeurosis of the ext. oblique were divided and a 5 per cent. solution of carbolic acid was dropped upon two inguinal nerves, probably ilio-hypogastric and ilio-inguinal. The sac was then opened and found to be filled with blood and fibrin. When the testicle had been cleaned of the latter, it was found to be insensible to a needle or point of a knife.

CASE 5.—E. H., aged 73, No. 213 B., 1902. An old weakly patient with enlarged prostate, foul urine, and cystitis. He was admitted for an acute suppuration in the right half of the scrotum. The operation showed that part of the epididymis was gangrenous, but the testis only oedematous. The skin over the cord and round the testicle was frozen with anæsthile, so that their solation with the diseased tissues round them could be completed with but little pain. As soon as the cord had been drawn sufficiently forward to see that the parietal peritoneum had been to some extent separated from the abdominal wall, two short forceps were placed upon the cord transversely, and between the two a tight ligature of catgut was drawn. The cord was then divided about $\frac{1}{2}$ to 1 cm. from the conjoined tendon. The patient seemed not to feel in the very least these various manipulations, whether crushing with forceps, or ligature and severance of the cord, which took place about 7 cm. above the caput epididymitis.

Later, I operated an another similar case with suppuration in the epididymis and scrotum. When the testis and cord had been dissected from their surroundings up to the ring, the testis was burned deeply with the actual cautery without any pain or even sense of touch or heat. The blood circulation in the cord and testis appeared to be unaffected. Again, in a man aged 21, the same operation as in Case 3 was performed for a very large hydrocele. The testis and epididymis were insensible to contact with warm instruments, to pricking or scratching with knife

point or needle. In these last two cases skin and areolar tissue were rendered insensible by the use of anæsthile.

The difficulty of testing the sensibility of this organ is great on account of the cremaster reflex. But the few facts which I am here able to record strengthen the conclusion drawn from other observations, that those organs which are innervated by the sympathetic alone are destitute of feeling.

