pressure would frequently rise to 180 mm. or 200 mm. of mercury, and then suddenly fall to 80 or 90 mm., and never rise again. In a subsequent Rubin test the gas rarely rose above 120 or 130 mm. before patency was re-established.

There were thirty-three cases in which pregnancy followed the Rubin test, after periods of sterility varying from two to eighteen years. In most instances the pregnancy followed surprisingly quickly after the first successful patency test.

In all cases of sterility, of course, the routine examination of sperms, etc., was made. But in many instances where the sperm activity was impaired Rubin tests were done either to promote greater facility for conception or at the urgent request of the patient.

The greatest number of tests in a single patient was seven. Many cases had from three to five tests before complete patency was established. In many the patency is quickly and permanently established at the first test, but in others one or more tests with a pressure of from 200 to 240 mm. were required to effect a passage of the gas. Not infrequently pregnancy followed quickly upon an inconclusive and unsatisfactory test, where even under a pressure of 220 to 240 mm. there were no appreciable signs of the gas having gone through. The most reliable clinical sign of patency after the Rubin test performed upon a conscious patient is the characteristic shoulder pain occurring a few minutes after assuming the sitting posture.

My method consists in sitting the patient up immediately after the withdrawal of the intrauterine tube, and then asking her to tell if or when she feels anything unusual. It is thought prudent not to tell her what to expect. When not knowing the signs, she is not led to imagine the desideratum. Almost invariably the first sign of the development of the shoulder symptom is a subconscious movement of the hand to the opposite shoulder. This is a sign that the gas has reached the subdiaphragmatic area, and the pain is referred to the shoulder as in gall-bladder trouble. It is readily conceivable, however, that the amount of gas which passes through a very small aperture of a tubal stricture may be so slight as to get lost among the coils of intestine and therefore never reach the diaphragmatic area, and similarly the small leak through the Fallopian stricture may not be appreciable in the fall of the mercurial level, which is the second most constant sign of patency. Most striking among this class was a physician's wife, sterile for eighteen years. The Rubin test rose to a pressure of 240 mm. without any evidence that the carbon dioxide had gone through, but she became pregnant the next month, though no hope for such an outcome had been given her.

The most interesting type of case is that which permits gas to penetrate in small quantity at 240 mm. of mercury. Three months later gas penetrates at 200 mm., and at each seance the pressure required is progressively lower. Then pregnancy supervenes.

It has always been a question what can be the pathology of these occlusions that give way before gas pressure. By a process of exclusion one may state that it cannot be a tube filled with fluid and therefore occluded at both ends. By the lipiodol test one can see cases of obstruction at either the cornual or the fimbriated end. But clinically I am convinced that the great majority of those cases of obstruction that yield to pressure are strictures at the intramural section of the tube, and that most of these are due to a peritubular lymphangitis and cellulitis of a mild nature. In corroboration of this one finds a great number of the successful therapeutic Rubin tests are those that are done upon patients who have had an infected abortion and have become sterile after this. Many of

my cases were of this type, and they are those in which a successful therapeutic Rubin may be expected. In two such cases Rubin tests were done five and seven times respectively before pregnancy occurred. In the one, pregnancy did not occur until gas went through at 140 mm. at the seventh sitting, thereby registering a slow drop from 240 mm. In the other instance, five repeated tests at from 200 to 220 mm. had given negative results as to penetration, but in spite of that the patient became pregnant after the fifth unsuccessful test. Both these cases, like many others, followed incomplete abortion and digital evacuation of the uterus.

Singularly enough, though there was definite obstruction of the tubes in all thirty-three successful pregnancies following the therapeutic tests, in not one was there an ectopic gestation. One would be led to think that the greater motility of the sperm over that of the ovum, and its smaller size, would enable the sperm to traverse where an ovum could not. But definitely such is not the case.

Anaesthesia was required in only eleven of the cases for the Rubin test, owing either to constricted cervix or to extreme nervousness or fear. The symptoms and signs of a successful Rubin test are much more convincing and emphatic with the conscious than with the unconscious patient. In only one instance was there any unpleasant sequel to the consulting room application of the Rubin test with carbon dioxide gas and a carefully adjusted pressure and water gauge and mercurial manometer.

THE PROPERTIES OF HALIBUT-LIVER OIL

BY

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Within the last few months considerable interest has been shown in halibut-liver oil as a source of vitamin A and vitamin D for use in the treatment of malnutrition, and there is no doubt that the product is already proving of great value in the hands of the medical profession.

The liver of the halibut (*Hippoglossus hippoglossus linnaeus*) may show considerable variation in the amount of oil present, but of greater significance is the curiously wide variation in vitamin A value which is encountered. Lovern,¹ and Heilbron and others,² have drawn attention to these differences, for which, as yet, no satisfactory explanation has been advanced.

In examining the question of the origin of the vitamins in the liver of the cod, Drummond and Hilditch³ were led to suggest that although the normal food of this fish contains only very minute traces of both A and D, accumulation might take place and in time produce the oils of high value that are encountered. Interesting confirmation of this view has recently been put forward by Macpherson.⁴ He has shown from an examination of the liver oils of individual codfish that there is a general relation between the age of the fish and the reserves of A in the liver, which indicates that accumulation does occur.*

In addition to this gradual storage which tends to produce high vitamin oils in the older fish, there are variations caused by changes in the amount of oil present in the liver at different periods of the life of the fish.

Whether these views can be extended to cover the remarkable vitamin A values encountered in some halibut-liver oils remains to be determined. Meanwhile it is of interest to place on record the results of the examination of a number of authentic halibut-liver oils of known

* We are indebted to Dr. H. Thompson and Dr. Macpherson of the Fishery Research Station, Newfoundland, for the opportunity to read the account of this work before publication.

origin. We have been able to trace only three analyses of the oil in the literature, and for comparative purposes the data from these papers have been included in the table setting out our own results.

Of the eight samples examined by us seven were known to be uncontaminated liver oil from the halibut. That referred to as "Danish" was a commercial sample for the authenticity of which we cannot vouch. It proved to be in some respects abnormal in comparison with our own products.

The analytical and other results given in Table I show that there are no obvious correlations which might be of significance from the standpoint of the medicinal value of the oils. We had expected that there might be

CORRELATION BETWEEN "BLUE VALUES" FOR HALIBUT-LIVER OILS AND SPECTROSCOPIC ASSAY OF VITAMIN A

There has been much discussion recently regarding the value of the colour test with antimony trichloride in evaluating cod-liver oils in terms of vitamin A. It is, we think, generally conceded that the method, particularly when applied to the unsaponifiable fraction, is of considerable utility in arriving at an approximation to the vitamin A value. On the other hand, evidence is accumulating to show that great reliance can be placed on measurements of the intensity of absorption of light at 3,280 A.U. as a method of assaying vitamin A in such materials as liver oils.

TABLE I

Sample in Order of "Blue Value"	The Oil							The Unsaponifiable Fraction					Remarks
	(1) "Blue Value"	(2) Vit. A Spectrophotographic	Sp. gr.	Refr. Index 40° C.	(3) Colour	Iodine Value	Sap. Value	Non-Sap. Matter	Iodine Value	(4) Cholesterol Per cent.	"Blue Value"	(5) Loss of Vit. A on Extraction Per cent.	
Danish ...	300	0.72	0.924	1.4734	5.3	136.5	177.3	8.15	112.6	71.0	3,605	2.0	Darkened with alkali
Exp. batch ...	655	1.512	0.924	1.4755	8.1	135.3	172.9	10.30	133.6	72.1	6,470	Nil	—
06 ...	670	—	—	1.4750	8.1	132.6	173.0	10.10	150.0	67.8	5,840	3.0	—
010 ...	749	1.68	—	1.4745	9.2	128.3	172.6	10.60	142.0	—	7,100	Nil	From the Faroes
09 ...	755	—	—	1.4750	7.0	129.6	172.0	9.45	133.2	—	6,370	20.2	—
011 ...	783	—	—	1.4741	7.0	128.7	176.8	9.18	145.5	—	8,580	Nil	—
012 ...	830	—	—	1.4721	6.0	120.0	179.8	9.36	148.1	—	7,670	13.5	—
Sp. 3000 ...	1720	3.89	—	1.4780	14.2	135.0	174.6	12.70	199.0	43.4	13,640	Nil	From Greenland
Emmett's ⁵ ...	—	—	0.927	—	—	118-126	179-193	7.44	—	—	—	—	"Commercial sample"
Evers's ⁶ ...	475	—	0.9229	1.4705	—	127.0	170.0	9.76	68.0	73.0	—	—	"Solvent extracted"
Tsujiimoto's ⁷ ...	—	—	0.9332	1.4780	—	160.3	174.9	11.08	—	72.0	—	—	"Extracted"

NOTES.—(1) In dilution to give 5 to 8 units, Lovibond scale, referred to a 10 per cent. solution. (2) By Hilger echelon wedge cell spectrophotometer. (3) In 1-inch cell, Lovibond tintometer. (4) By digitonin method. (5) Calculated.

a rise in the amount of unsaponifiable matter associated with an increased vitamin A content, but, except that the oil of the greatest potency is also that with the most unsaponifiable matter—whilst the weakest oil contains the least—the intermediate samples show no such correlation. With regard to the cholesterol content of the unsaponifiable fractions Channon,⁸ from the study of many fish-liver oils, suggested that the cholesterol content varied inversely as the proportion of unsaponifiable matter. This is roughly borne out by our results, since the oil which contains the highest unsaponifiable fraction shows the smallest cholesterol content.

Several of the values for oil 012 are appreciably different from the majority, and it is also interesting that this oil, although pale in colour, is one of the richest in vitamin A. The correlation between vitamin A and natural yellow colour is not as distinct in the case of this oil as in that of cod-liver oil.^{3, 4}

The fatty acids from one oil were examined in some detail. The results are given in Table II.

TABLE II

Sample of Oil	Fatty Acid			Unsaturated Fraction				
	Refr. Ind.	Equiv. Weight	Iodine Value	Refr. Ind.	Equiv. Weight	Iodine Value	Insoluble Bromine Value	Hexabromide
Exp. batch ...	1.4631	314.0	141.0	1.4778	298	243.5	74.2	6.9%
Danish ...	1.4559	294.3	—	—	—	—	—	—
Sp. 3,000 ...	1.4600	273.8	118.3	—	—	—	—	—

We were fortunate in having the co-operation of Dr. R. J. MacWalter, who very kindly estimated the vitamin A present in four of the oils, and a mixed oil of intermediate value, by means of the Hilger spectrophotometer. The results are set out in Table III.

TABLE III

E 1 % 1 cm.	Percentage Vitamin A	Blue Value 10 % Dilution
11.52	0.75	300
24.20	1.512	655
26.85	1.678	749
47.20	2.95	1,268
62.23	3.89	1,720
1,600.00	100.00	44,080

The graph correlating Dr. MacWalter's values for the extinction coefficient at 3,280 A.U. in a concentration of 1 per cent. (E 1 cm./1 %) with the "blue values" obtained by the SbCl₃ test on the oils is given in the figure.

The straight line relation is quite remarkable. By extrapolation to the value E 1 cm./1% 1,600—the highest recorded figure for the purified vitamin A—the "blue value" of the vitamin referred to 10 per cent. dilution

would be 44,080.⁹ This result encourages us to believe that the $SbCl_3$ test is trustworthy for assaying the vitamin A value of halibut-liver oils of high potency. We are inclined to believe that solvent extracted oils, of which some are on the market, should be examined by applying the test to the unsaponifiable fractions.

It is a curious fact that, although the liver of the halibut may contain 20 to 30 per cent. of oil, the direct treatment with live steam—such as will readily liberate the same proportion of oil from cod livers—does not break up the tissue and release the oil. Considerable modifications of the steaming process have to be employed before the yield is entirely satisfactory. Lovern¹ has also reported the poor yield derived from direct steaming. In order to ascertain whether this curious difference in behaviour is due to the fat being distributed in a different manner in the two tissues, sections of the two livers were submitted to microscopical examination after staining with Sudan III, but except for the fact that halibut liver appeared to contain slightly more connective tissue than did the cod liver, no marked difference was observed. As soon as fresh livers become available from the spring catch this problem will be further examined.

Our thanks are due to Dr. MacWalter for his spectrophotometer determinations, and to Mr. G. Napier for assistance in making the estimations of the "blue value" of various oils and concentrates.

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EFFERENT FIBRES IN THE ILIO-INGUINAL NERVE AND THEIR RELATION TO INCISION FOR APPENDICECTOMY

BY

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A number of observers have noted that a right inguinal hernia may follow the McBurney muscle-splitting incision, and one authority has placed its occurrence as high as 30 per cent. The cause of the hernia has not been exactly determined, but Southam¹ has recently advanced evidence which strengthens considerably the view that this unfortunate sequel arises from interference with the ilio-inguinal nerve. At the operation for the cure of the inguinal hernia a piece of the ilio-inguinal nerve was excised in three cases. Subsequent examination of the excised portions of nerve showed partial degeneration, and the histological appearance was consistent with compression at a higher level by scar tissue. It is well known that the ilio-hypogastric nerve may partially or completely replace the ilio-inguinal, and there is reason to believe that both should be under suspicion when one attempts to discover the origin of the inguinal hernia after the muscle-splitting operation. Most anatomical books refer somewhat vaguely to the distribution of these two nerves to the muscles of the abdominal wall, and it was with the intention of procuring more precise knowledge that twenty dissections have been undertaken.

After exposure of the muscles of the lower part of the abdominal wall the ilio-inguinal nerve was secured in the inguinal canal, and carefully traced proximally and distally to its finest ramifications. A gross study was

made, and, in addition, several pieces of muscle were removed with the endings of the nerve and were subjected to microscopical examination. The results of this investigation may be summarized as follows:

1. The lower fibres of the transversalis abdominis and internal oblique muscles—including those which are inserted by the conjoint tendon—receive a considerable supply from the ilio-inguinal nerve, and also from the complex plexus formed by this nerve and the ilio-hypogastric as they lie between the two muscles.
2. The presence of a constant branch from the ilio-inguinal, or the nerve replacing it, to the region of the anterior superior iliac spine to supply the oblique muscles and the integument.
3. The dissections showed that the ilio-inguinal and ilio-hypogastric nerves are closely related and form a plexus, but it is evident that the former is distributed to the internal oblique and transversalis (and in a few instances also the external oblique), while the latter innervates only the oblique muscles.

It is apparent from this investigation that a considerable proportion of the lower fibres of the internal oblique and transversalis muscles receive their innervation from the ilio-inguinal and ilio-hypogastric nerves, and that interference with the function of the former alone is likely to cause appreciable muscle weakness and predispose to the development of an inguinal hernia. My dissections show that the McBurney muscle-splitting incision may lead to implication of these nerves above the point at which fibres are distributed to muscles, but it does not seem possible for any motor disability to result from damage to the nerves in the field of the operation for the radical cure of an inguinal hernia. As regards the ilio-hypogastric nerve, the latter statement is supported by Andrews,² who failed to obtain any muscular contraction on stimulating the distal end of the nerve in the inguinal canal.

CONCLUSIONS

1. Injury to the ilio-inguinal nerve, especially if it is associated with damage to the ilio-hypogastric nerve, will lead to appreciable weakness of the fibres of the internal oblique and transversalis muscles which are inserted by the conjoint tendon.
2. Such weakness must predispose to the development of an inguinal hernia.
3. Muscular weakness will follow injury to the nerve, or nerves, at the level of the McBurney muscle-splitting operation, but not from damage in the inguinal canal.

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Memoranda

MEDICAL, SURGICAL, OBSTETRICAL

SIGMOID IMPLANTATION OF URETERS FOR GROSS VESICO-VAGINAL FISTULA

The condition of those patients suffering from intractable vesico-vaginal fistula is so utterly miserable that any means available for their relief should be tried, even though of a drastic nature. The two patients whose cases are here reported were in a horrible state, offensive alike to themselves and to their neighbours. Constantly soaked in urine, and suffering from extensive and painful excoriation of the thighs, they deeply appreciated the relief obtained by the diversion of urine to the bowel, and the mental and physical change effected was a pleasure to see.

CASE I

A married Turkish woman, about 35 years old, had a difficult confinement in her village two years previously, following which she was extremely ill for two weeks. During