The Mackenzie Davidson Memorial Lecture ON THE RELATIONSHIP OF RADIOLOGY AND SURGERY.

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BY

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It must, I feel sure, be difficult for the younger generation of physicians and surgeons fully to realize the magnitude and the high value of the help that is now given to us by the work of the radiologist. Each generation inherits the work of its forerunners, and it requires an effort of imagination denied to most of us to picture the conditions of earlier days in which many of our present resources were still undeveloped. None of us, I think, quite appreciated the difficulties against which Lister had to contend in his early investigations until we were suddenly confronted with the nauseating and startling horrors of those heavily infected wounds with which we had to deal in the first few months of the great war. And the lessons we learnt then increased; if that were possible, both the admiration we all felt for the toilsome and honest work that Lister did, and our gratitude for the imperishable heritage which he bequeathed to us.

So it is also with radiology. It requires a considerable effort of memory, and some skill in reconstruction, to recall for ourselves the days when only the note given by a sound in the bladder as it impinged against a stone made certain the diagnosis of calculus. The word "certain" is too emphatic; for I can still vividly remember Marcus Beck telling us in his ward at University College Hospital of the errors in diagnosis that might then arise when the sound struck the spine of the ischium and produced a muffled note, or when a trinket on the watch chain of the surgeon tinkled at the moment the instrument was rotated in the bladder. Nor can I easily forget the infrequency with which an exploratory operation upon the kidney revealed the presence of the stone whose existence had been confidently predicted, nor the uncertainty and ill success which attended the search for a calculus in the ureter. The change from those days, with the hesitation, the guesswork, the bitter and humiliating disappointments, to these days of confidence and precision is almost immeasurable; and it is to the devoted and skilful workers in the fields of radiology that we are grateful for the transformation. It is natural and fitting that this day should be held as a day of remembrance for one of the greatest of the pioneers—Mackenzie Davidson. It will, perhaps, be appropriate if, in my role of a physician doomed to the practice of surgery, I endeavour to show, more particularly in connexion with abdominal diseases, in what degree we have taken advantage of the new methods of diagnosis and of treatment which radiology has afforded us.

DIAGNOSIS.

Let me begin with the pharynx and oesophagus, though an evening's entertainment might not unprofitably be devoted to a discussion of the value of radiology in connexion with the disorders, real or assumed, of the hidden portions of the teeth. It is true that diverticula of the pharynx were known long before the days of radiology. The first case was related in a letter from Mr. Ludlow, a surgeon of Bristol, to Dr. William Hunter of Glasgow, and is recorded on page 85 in volume 3 of the *Medical Observations and Enquiries* of 1767. Ludlow speaks of a "preternatural bag" in the pharynx. The figures he gives are exquisite, and are unsurpassed for beauty and accuracy by any later illustrations. The specimen is in the Hunterian Museum at Glasgow to this day, and a recent drawing of it shows that it has changed very little in the last 150 years.

The diagnosis of the condition in its fully developed state

is not difficult. Radiology not only makes the diagnosis quite certain, but it gives a quality of precision that could not otherwise be obtained. We learn not only that the preternatural bag is there, but we know where it lies, how large it is, what attachments it has made, and all details that may be helpful to us at the time of operation.

Of diverticula of the oesophagus we knew nothing before the days of x-ray examinations except that which was learnt from *post-mortem* examinations. These little way-side tracks are not often of clinical importance. When filled with food they press upon and distort the tube from which they spring, and cause an uneasy suspicion as to the presence of cancer, a suspicion that only time allays.

Oesophagus.

Of the condition known as cardiospasm we could, of course, know nothing accurately apart from the examination made by the radiologist. It is true that our museums contain many specimens of "idiopathic dilatation of the oesophagus," but the recognition of this deformity, the knowledge of the size, position, capacity, and occasions of emptying the pouch, the extent of the tube involved, and the position of the barrier, we learn only from the screen examinations. In the first case I saw after I had just learnt of the disease from Professor Mikulicz we had "washed the stomach out" many times, and removed from it large quantities of fermenting, offensive, and disintegrating food that had been long retained. When this little operation was repeated under the control of the x ray we saw with amazement that the tube never entered the stomach, but lay coiled within the immense cavity formed by dilatation of the oesophagus. We failed completely to pass any bougie into the stomach though careful and repeated attempts were made. A duck-shot tied on to the end of a long piece of silk at last was seen on the screen to enter the stomach and to pass along the intestine until it emerged at the anus. When all the length of silk was entangled in the intestines and formed there a fixed point, I threaded bougies over the strand hanging from the mouth and so guided them safely into the stomach. The obstruction was fully dilated, and the patient taught to pass bougies. When she was expert the silk was cut at the mouth and at the anus, and a week later the whole length of it was vomited. Since those early days I have treated many patients, and though examinations with the oesophagoscope are made, we still rely chiefly upon the radiologist for the information which directs our treatment. There is no doubt that most of these cases were formerly regarded as malignant, and gastrectomy was done for them. A patient in the Leeds Infirmary was seen by me twenty years after this operation had been performed by Mr. Ward, on the supposition that a carcinomatous growth obstructed the gullet. An x-ray examination showed the typical appearance of this disease.

The differentiation between "cardiospasm" and carcinoma now presents no difficulties, for the appearance of the oesophagus filled with an opaque medium is quite characteristic in both diseases. The large size of the oesophagus, its tolerance to food, the vigour of the peristaltic waves, which do not move the meal forward, the rounded, blunt end of the shadow which reaches to the diaphragm in cases of cardiospasm, contrast as sharply as possible with the slight distension of the oesophagus, the intolerance to food, the incompleteness of the obstruction, and the narrow tapering of a shadow which is very rarely exactly on a level with the diaphragm, in cases of carcinoma.

Diaphragmatic hernia is a rare disease. Its recognition without the aid of radiology is excessively difficult or perhaps impossible. It so happens that I have had four cases in my charge—two in the time before we used the x rays and two since. Neither of the first two was recognized until the abdomen was opened, and both were discovered with a shock of surprise. The latter two had been recognized by the radiologist; one was on the left side, as most cases are; in the other the sac lay in the right side of the chest, and its contents—the stomach and the transverse colon—were easily recognized in the radiograph. I know of only one other similar case; it was operated upon by Sir Hugh Rigby.

Ulcer of the Stomach.

In connexion with gastric disease it is hardly too much to say that we owe almost everything to the radiologist. As we look back upon the history of gastric ulcer in respect of its symptoms, its diagnosis, and its treatment, we must now realize that before the radiologist came to the rescue there was little that could meet with our confident acceptance. I do not doubt that more errors have been made in the diagnosis of gastric ulcer than of any other disorder. Its symptoms are mimicked with so much accuracy by other diseases that it is not only the unwary who are deceived. The radiologist has put all this right, or nearly right, and has, I think, explained the cause of the so remarkable plagiarism by those other diseases which arouse gastric symptoms. It is, however, not only diagnosis that has been at fault, but the treatment that has been based upon it. How can we explain the devotion of physicians to the alkali treatment of gastric ulcer except on the assumption that the diagnoses upon which such methods first were founded were erroneous? For in about 80 per cent. of the proved cases of gastric ulcer the free hydrochloric acid content of the gastric juice is either normal or below normal or absent. And the surgeon is far from guiltless in the matter. He has too often been content to accept the diagnosis of "gastric ulcer," and, basing his treatment upon it, has performed gastro-enterostomy, which, unhappily, he has been led to believe is a panacea for all gastric disorders and a swift and certain cure for gastric ulcer. The accuracy with which a competent radiologist, given time, can make a diagnosis of chronic gastric ulcer which the operation will confirm must in time lead to the abolition of these foolish practices by us all; and radiology will prove the most effective remedial agency for the loose talk and incoherent thought which distinguish so much of the literature and practice of days that are not yet past. May I urge once again that, until our knowledge is clarified and our practice established in reason, no diagnosis of gastric ulcer based upon clinical evidence alone be accepted as a warrant for treatment? A chronic gastric ulcer, unlike the Emperor's new clothes, is a real thing. It is to be seen, and during operation can be handled, exposed, and demonstrated. If it is there at all, it is there for all to see. No gifts of vision are conferred upon the surgeon which are denied to the onlooker. If the surgeon says an ulcer is there, any competent witness can test the truth of his statement. And the accuracy of the radiologist in the diagnosis of this disease nearly approaches that of the surgeon who inspects and handles the stomach. The radiological diagnosis of gastric ulcer is not, however, constant in its accuracy. The greatest difficulties are met with when the ulcers are small, lie on the lesser curvature, are close to the cardiac orifice, and veer towards the posterior surface. The sheltered position of the part of the stomach which harbours them, the overlying liver, the barrier made by the wall of the thorax, and the impossibility of direct palpation of the stomach here, all are hindrances to the exact methods applicable to the exposed gastric area. All these difficulties are, however, in some degree surmounted if the dark meal is carefully watched as it enters the stomach, if the patient is placed in the Trendelenburg position, and if convergence of the folds of the gastric mucosa to a definite point is observed. There are times when an ulcer may be demonstrated if the filled stomach is pressed down from the epigastrium by a pad of wool, more and more increased in size; the stomach is thus rotated a little on its long axis, and an oblique or transverse view may then disclose an ulcer crater. The occasions of error in diagnosis are, however, so few that radiology remains easily supreme above all other methods in the accuracy of the diagnosis made with its help.

If the diagnosis of gastric ulcer is made by no matter whom, let us agree that it is not to be acted upon by the therapist with drugs or weapons unless the radiologist confirms it. It is admittedly true that this expert may sometimes fail to see an ulcer which is undoubtedly present, especially if he is hurried in his examination by the impetuosity of the physician or the impatience of the sufferer himself. But, given a good chance, his errors will be few, far fewer than those of any other investigator. And it must be conceded by us all that the value of any treatment

—dietetic, medicinal, or operative—cannot be gauged unless we know the precise condition for which that treatment has been prescribed. At present, with the best will in the world, I am unable to learn anything which satisfies my intelligence as to the worth of any of the methods of medical treatment in cases of gastric ulcer. And I am not often without the opportunity of seeing lamentable examples of mischievous and meddlesome surgery practised upon those who were unmistakably arraigned as the victims of gastric ulcer in need of surgery. In all parts of the world operations are being practised by those whose natural gifts may perhaps warrant their ambitions to be surgeons, but whose apprenticeship to the most superb and most difficult of all the arts has not been served with that devotion and surrender which alone equip a man for this office. I am amazed at the ready acceptance by patients of the eager ministrations of incompetent operators, when adequate skill and experience are at their command. The frequency of secondary operations when the first, being needless, yet produced effects that must now be undone, and of skimpy operations for carcinoma, say of the breast, which invite a quick new growth of cancer cells distributed over the exiguous wound, are a reproach to surgical work.

I think that the radiologist has done much to explain the reasons for the so frequent inaccuracy of the diagnosis of gastric ulcer. When we inquire as to the conditions which cause the symptoms of this disease, we who deal with the living are quick to admit that it is not only the presence of an open ulcer, with its crater of varying depths, that is the responsible and immediate agent; for it is a very common experience to find an open ulcer when the symptoms are in temporary abeyance, the patient enjoying one of the "intervals" so characteristic of the disease. I believe that a state of active increase of the ulcer is essential to the production of symptoms: when activity dies down and the ulcer makes an endeavour to heal all is quiet. The enlarging ulcer sets up a spasm in the stomach—the "incisura" of the radiologist. The "notch" on the greater curvature, opposite, or about exactly opposite, the "niche" on the lesser curvature, is sometimes so deep that it seems to cleave the stomach into two parts. Watched attentively for as long a period as is safe, and examined from time to time, it appears unchanged. The conclusion at first was irresistible that an hour-glass stomach existed. Yet when an operation was performed the spasm had vanished. The cause of the symptoms of an ulcer seems clearly to lie in this spasm. The pain is doubtless due, in part, to the distension of the zone lying on the cardiac side of this spasm.

The occurrence of spasm is not, however, restricted to cases of gastric ulcer. There is a reflex spasm which in many of its qualities so closely resembles the direct spasm that in haste a false conclusion as to the presence of an ulcer may be drawn. The reflex spasm, even when it is as deep as the direct spasm, is rarely so constant, or so immobile; it is apt to be shallow, fugitive, changing from one part of the stomach to another, and at each part persuading one that here, at least, is an ulcer. Such a spasm may be excited by conditions so diverse as cholecystitis, tuberculous disease of the intestine or caecum, chronic appendicitis, and certain conditions of the central nervous system. No gastric ulcer, of course, exists without infection; infection may be present, too, in the pyloric part of the stomach when its primary source lies elsewhere. It is long since I described the "pyloric blush" of chronic appendicitis, and Braithwaite's work¹ in this connexion is full of interest. If, therefore, these two conditions, spasm and infection, are present both in the true and in the apparent disease of the stomach, there is little wonder that the symptoms aroused by them should often lead even the alert and earnest diagnostician astray. The only competent authority to distinguish before operation between the spurious and the true is the radiologist, and, as I have before ventured to claim, his work has pride of place among the methods of diagnosis in all forms of gastric disease.

It is not only in the diagnosis of gastric ulcer that our resources have been so greatly augmented, but in the recognition of its occasional complications. Many years ago I laboured hard to discover, and in several papers elaborately described, the various signs which permitted the hopeful recognition of an hour-glass stomach. The signs

were many, the labour to elicit them protracted, the judgement difficult and not free from faults. Now the radiologist will tell us every detail that is relevant; not only is the diagnosis indisputable, but the site of the constriction, the size of the two complements of the stomach, the speed with which one or other will empty, the degree of adhesion if any—all, and even more than these, are stated with unequivocal accuracy.

Cancer of the Stomach.

We shall all, I do not doubt, be prepared to concede our inability to diagnose cases of carcinoma of the stomach in an early stage. Of gastric carcinoma there are, speaking roughly, two great groups. In the one the patient has suffered for years at intervals from mild or severe forms of gastric discomfort. Finally, one attack, at first very like all the others, proves rebellious. Relief is not given by the remedies which hitherto have proved so easily successful. At the operation an ulcer, transformed in part to carcinoma, is found. In the second group are the cases I refer to as "the bolt from the blue type." The patient has perhaps been notorious for vigorous gastric health: he scorns the suggestion that he may perhaps have been a little dyspeptic. His denial of former ill health is disdainful to the point of arrogance. Suddenly he becomes ill, and perhaps the illness is ushered in by haematemesis of great severity. He loses zest for many things—food, his former activities of work or play; he loses weight, becomes anaemic, and when he is examined a lump is felt in the epigastrium. It is a melancholy but indisputable truth that, despite the activities of a small body of surgeons in this country, carcinoma of the stomach is almost always an incurable and fatal disorder. I should doubt if there are a hundred patients in the whole country who are alive and well five years after operation for the second type of carcinoma to which I have just referred. The reason for this lamentable condition of affairs lies chiefly in our incapacity, by any clinical means, to make a diagnosis in the early stage. As a profession we are not, however, blameless. We have not the courage of our experience. For when a patient over 45 begins with these insidious failures of health our tendency is to procrastinate, when we should not delay a moment. Lives are lost in part through ignorance, in part through timidity. The radiologist is now our strength. He is able, given time, to make a diagnosis of filling defects, to recognize interrupted waves of motion, of a break in peristalsis on the affected curvature, whilst the movement on the normal curvature is unchecked, of deflections of the current of the opaque meal, long before we could be in the least degree confident, by any other means at our command, of the presence of a growth. To ensure a success in treatment greater than that most meagre form we now command, two changes are essential: all patients about whom we have a doubt should be sent forthwith to the radiologist; and the x-ray examination should not be hurried.

Diverticula.

What should we know of diverticula of the duodenum but for the radiologist? I have carefully searched the literature of this subject, and though the condition was first described in 1710 by Chomel, no case had been diagnosed during the lifetime of a patient before 1912. Yet J. T. Case, in a study of 6,847 consecutive patients upon whom a radiological examination of the stomach and duodenum was made, found no fewer than 85 cases of diverticulosis. Not many of the patients who possess these little wayside tracks from the duodenum suffer from them; their removal is therefore rarely necessary. But regard should be paid to them in all operations in which a diagnosis of duodenal ulcer, or of cholelithiasis, is not supported by the conditions disclosed at an operation, for the retention of foodstuffs in these cavities, or its fermentation, may cause symptoms which are apt to be ascribed to other lesions, and when these are not found on inspection the operation may, in ignorance of this condition, be abandoned as a failure.

Of diverticula of the jejunum occurring during life nothing could be known apart from their demonstration by x-ray examination. The cases are few in number, and the little pockets do not often cause much harm. This is all

to the good; for when present they are apt to affect so great a length of intestines as to make removal of the affected segment a matter of difficulty, or even impossible. The best example that has fallen within my knowledge occurred in the practice of my colleague Mr. Braithwaite, the radiological examination and the diagnosis being made by Dr. Rowden.

Colon.

The subject of radiology in relation to diseases of the colon has so recently been discussed in London that I need say little concerning it to-day. When I operated upon the first case recognized as diverticulitis in this country on April 2nd, 1906, so slight was our knowledge of the disease that a diagnosis during the life of the patient had never been made. Many of the specimens on our museum shelves bearing the label "carcinoma" were examples of the massive inflammatory thickening round these little crypts, and the fact that the majority of the fistulous tracks from the colon to the bladder were not due to carcinoma was generally unrecognized. The diagnosis of diverticulosis is now made with complete confidence by the radiologist, and by comparison of one radiograph with another taken some months later we are able to judge of the progress of the disease and to come to a decision as to whether operative treatment is likely to be necessary.

I have a number of patients suffering from this disease who are kept in good health, and are sheltered from the attentions of the surgeon, by medical treatment. This ensures a daily emptying of the intestine, and includes an orgy of aperients on the Saturday afternoons and Sundays which are given over, religiously, to the observance of the ritual of free and frequent evacuation. I find that operative treatment in the chronic form of this disease is rarely necessary.

The diagnosis of carcinoma of the large intestine may present such difficulties to the radiologist that great care is needed to avoid error. The opaque meal and the opaque enema both have their uses, but I find far greater help from the latter. Owing to the loading of the colon, and the tenacity with which faecal masses will adhere to the mucous membrane, some days may have to be spent in the administration of aperients, and in lavage of the colon before it is empty. A small hard adherent mass of faecal material will show the same filling defect as a growth, and imprisoned gas will prevent the entry of the opaque material. Spasm of the colon, especially in heavy smokers, may suggest an organic stricture, and the overlapping of one part of the bowel by another may cause a deepened shadow or prevent a free entry of the barium mixture. I have been misled both by negative and by positive diagnosis made by the radiologist, but I have been far more often aided than hindered, especially if a day-to-day examination of the faeces for blood, when the diet is free from haemoglobin, has been made. By collating these two methods of examination, radiological and haematological, with the clinical history we are able to recognize malignant disease of the colon before a tumour can be felt, and before obstruction has developed; and having regard to the fact that the colon lends itself to removal better than most parts of the body, and that recurrence after early operation is rare, this a great achievement.

Gall Bladder.

The recognition of diseases of the gall bladder is now receiving help from the radiologist. In making a diagnosis we are all accustomed to speak of cholelithiasis—to say that a patient is suffering from "gall stones." But I believe that we shall be able before very long to look upon gall stones in much the same way as we now regard haemorrhage from a duodenal ulcer, or its perforation—that is, as a quite unnecessary complication. Gall stones are the expression of tedious events in a terminal stage. Despite my friend Røvsing of Copenhagen, I have unchanged belief in the view that gall stones are the consequence of infections which reach the gall bladder from one or more of several sources. Our business is to search out the inaugural symptoms, the symptoms of infection of the gall bladder, and to use all the means that the radiologist—employing, too, the method of Graham—can

bring to our aid. I look forward hopefully and not without confidence to the day when we shall regard cholelithiasis as a preventable disorder. It is true that the clinical diagnosis nowadays is not often at fault; we are able to predict the presence and the position of stones in the gall bladder or the ducts with a large measure of certainty. Even the pre-calculous stage of this disorder is becoming day by day easier to discover. Though we can clearly see the gall stones on the radiograph in about one-third of the total number of cases in which they are shown by operation to be present, they are not often seen where they are not confidently expected. The indirect signs of cholecystitis are of more interest than the shadow of stones, for they display the changes which the disease has brought about in neighbouring organs by the presence of an enlarged gall bladder, or by the traction exerted by a shrunken gall bladder which has become adherent to them. The advantages of Graham's method would seem to lie chiefly in the opportunities afforded for research into the physiological activities of the gall bladder, and into the functions of the liver. We do not yet know in what circumstances and at what rate the gall bladder fills and empties, and we have still much to learn of the secretory activities of the liver. The absence of any shadow after the Graham injection has been made is indicative of a closure of the cystic duct by a stone or by a stricture. But a mistake in the recognition of these two conditions is almost unknown. The danger attaching to Graham's present method appears to be very slight, and doubtless, with enlarging experience, will disappear. The salt used by Graham is useless as a test for hepatic efficiency owing to the fact that its colour is destroyed in serum.

The x-ray examination of the gall bladder after its removal and of the stones which it contained shows that the smaller stones almost always contain nothing but cholesterol. A very few have a nucleus, or an ingredient, of calcium. It is only after a certain size has been reached, and a chronic irritation of the gall bladder has been incessantly at work, that calcium in little spots or as a thin film is laid down on the surface of the stone.

The conclusion I draw from the radiological work done in connexion with cholelithiasis is that it enables a diagnosis to be made which would, in rare instances, perhaps be in doubt; that it discovers the existence of associated lesions in neighbouring viscera; and chiefly that it is a powerful instrument of research in enabling us to discover the composition of stones, and therefore to learn something of the processes at work in their formation, and by Graham's method to add something to our very imperfect knowledge of the functions of the gall bladder and of the liver. In other conditions the help of the radiologist to the clinician is still more invaluable. In diseases of the kidney and ureter, in the discovery of stone within the bladder or of diverticula protruding from it, we are even in danger of allowing our clinical diagnosis to ignore the history, and to base itself confidently upon radiology alone. No doubt others are as weak as I am. When a patient complains of pain in the loins I am tempted to ask first what the radiologist says, and to accept his word as law. Indeed, he is so constantly right when the clinician alone would be so often in doubt that here too he is both guide and governor. The use of the "bonnet" which so greatly helped us in the removal of projectiles during the war may well be remembered when the kidney, delivered from the wound, is being searched for stones. And here, too, research work upon the normal and pathological anatomy of the kidney and ureter, after opaque injections have been made, and upon the chemical constitution of stones, has added notably to our knowledge.

One of the most delightful uses to which radiology has been put is that which Sicard introduced for the localization and discovery of tumours of the spinal cord. My knowledge of this comes from Mr. Percy Sargent. I confess that I felt a thrill of pleasure when I first learnt of this neat and ingenious method.

Limitations.

One very important point remains. All the methods, other than the application of our own senses directly to the patient which we so willingly use in the practice of

surgery, are after all ancillary. They strengthen our clinical armoury by adding weapons of varied and sometimes, as in the case of radiology, of immense value. But they all supplement our clinical resources; they do not, and cannot, supplant them. In regard to gastric ulcer I cheerfully acknowledge that the radiologist is, on the whole, a more competent and a more accurate diagnostician than I am. He has pride of place. But I find an occasional case when, being confident of the existence of an ulcer, I learn that the radiologist doubts, or even denies, the diagnosis which nevertheless an operation confirms. I accept with gratitude a positive diagnosis made by the radiologist; but if my clinical sense urges me, after the rebuff of a negative report from the x-ray department, to hold to my diagnosis, I may find my tenacity rewarded. In a long series of cases the radiologist will, however, prove to be right more often than the clinician.

When the clinical diagnosis of an ulcer, or of a diseased gall bladder, or of an enteric growth, is not confirmed by the x-ray report, what is to be done? The whole case must once again be reviewed. In cases of gastric ulcer I hesitate to go contrary to the report of the radiologist, but sometimes I am driven by my own confidence to do so. In cases of duodenal ulcer I prefer my own opinion, linked with that of the chemist, to that of the radiologist. If he gives a negative opinion and I am persuaded of the accuracy of my own, I am prepared to act upon it; and I find I am more often right than he is. In gall-bladder disease the clinician, if unsupported by the radiologist, should be prepared to act alone. I could quote many instances where patients, including medical men, have heard the diagnosis of cholecystitis from the clinician, and on learning that it lacks confirmation by the radiologist have been lulled into contentment and a dangerous inactivity, only to be roused by a very formidable catastrophe. If the careful clinician has made a diagnosis of cholecystitis or cholelithiasis, a report from the radiologist that gives it no countenance should be disregarded. And so it is with suspected malignant conditions of the large intestine. Though a radiological examination often affords the greatest help when confirmed with the clinical history, and with the daily search for occult blood, the earliest and the most certain diagnosis of these diseases, after all, is made when the barrier of the abdominal wall is lifted away.

THE THERAPY.

The treatment of carcinoma wherever it occurs is a disheartening business. The recognition by patients and by medical men of the earlier conditions of malignant disease, even in parts that can be seen or are easily accessible to examination, is unhappily infrequent. It seems almost incredible that patients should allow ulceration of the tongue, for example, to progress to a stage in which remedies are almost hopeless. The diagnosis presents no difficulties, and inspection of the tongue in a mirror ought surely to awaken anxiety. And at every meal time discomforts must be felt or limitations of diet be necessary. When a lump appears in the breast of a woman her natural timidity makes her, perhaps, unwilling to submit herself to examination. And when the tumour is plainly felt by a medical man no little time is lost in discussions as to its nature. Nothing but the microscope can settle the diagnosis in a difficult case; to wait for the appearance of those signs which convince the surgeon that the tumour is malignant is to give time for the disease to be disseminated. A review of many cases over a period of twenty years results in this interesting law: "In tumours of the breasts of women over 40 years of age, not less than 80 per cent. are malignant, no matter what the physical signs of the tumour may be." Diagnosis, therefore, is largely a matter of the age of the patient. It is a far more reliable guide than any other. Many cases follow upon chronic inflammatory lesions—in the mouth, in the breast, in the stomach, upon the skin, in the colon. Cancer, therefore, is often a preventable disorder. And in its early stages in most organs of the body it is a curable disorder. To the surgeon two facts about cancer appear indisputable: that it comes as a result of long-continued trivial irritation, and that it begins as a purely local disorder, and can in that stage be wholly eradicated.

It is pitiable to find so large a number of cases which are inoperable, or which, having been treated by operation, suffer recurrence. To deal with these cases many remedies have been sought. Radium has proved its value in some of them, and the application of x rays was soon included among our methods. Twenty years ago or more I sent all my breast cases, and all cases in which glands had been removed from the neck after excision of the tongue, to the radiologist. Of the effects produced by the methods of radiology in such cases it was difficult to judge. If the patient remained free from recurrence, one was unable justly to apportion credit between the radiologist and the surgeon; if the disease returned, both had proved powerless. I came tardily and reluctantly to the conclusion then that on the whole more harm than good was done, and I abandoned the method entirely.

When the deep x-ray methods were introduced I felt renewed hope, and with the most skilful and enthusiastic co-operation of Dr. Cooper I have submitted a very large number of patients to his treatment. An exposure to the deep x ray may be made (a) before operation; (b) during operation; (c) after operation; (d) when operation is impossible.

(a) Before Operation.

In my own practice this is not often adopted in cases of cancer; for I feel that if a growth is to be removed it may be possible to eradicate it to-day and impossible to-morrow, and I never waste one single day. But in cases of carcinoma of the breast, when the activity of the growth and the rate of its extension seem almost inflammatory, it may be worth while to apply the rays, not so much to the growth as to the area around it, in the hope that the cells in lymphatic vessels, which might be set free to implant themselves upon the surface of a wound, may be destroyed.

In cases of carcinoma of the rectum, or of the uterus, with much induration and thickening around the tumour, and when adhesions appear to be present, the rays may cause a change so great as to make one doubt the truth of the earlier observations. The growth shrinks, loses its induration and fixity, and from appearing irremovable seems now to offer no difficulty. In one case in which, in an enfeebled old woman, much distressed by a teasing diarrhoea, I had performed colotomy, the growth entirely disappeared. I had removed a gland at the time of operation, and the diagnosis of carcinoma was not in doubt. No doubt the growth will reappear, but its complete removal is an evidence of the great effect which the rays are able to produce. In all cases of splenic enlargement one or more exposures to x rays are given. The reduction in the bulk of the spleen is almost incredible: from filling the whole abdomen the organ shrinks until a lump the size of a golf ball is felt below the costal margin. Then the spleen may be removed with a safety and with such ease as could not be claimed for any operation upon it in its original state.

(b) During Operation.

In cases of Crile's operation upon the glands of the neck, and in cases of carcinoma of the breast, I think we might more often expose the entire area of operation to the rays before we close the wound. I have done this in a number of cases, and though it is impossible accurately to gauge its value, on theoretical grounds it certainly appears a very desirable procedure. I have long felt disheartened by our inability to perform more often than we do radical operations for carcinoma of the stomach. I therefore determined to enlist the help of the radiologist. The application of x rays to the surface of the abdomen, though it may rarely do good in these cases, does sometimes appear to do harm. I tried a new method. While the abdomen was opened and the stomach exposed I moved the patient to the x-ray room, and there, bringing the growth as far as possible into a widely opened wound covered by a single layer of macintosh gauze, I applied the lamp directly to the stomach for a period of forty minutes. The abdomen was closed. Seven weeks later in one case, nine weeks later in another, I reopened the abdomen and found the growths so changed and shrunken that I was able to remove them, with all their attached glands. Two operations of gastrectomy in this way were performed in 1923, and to-

day both patients are alive and well. One has gained 33 lb. in weight, another 9 lb. In both two transfusions of blood were given—one at the time of the x-ray exposure and one before the removal of the stomach was undertaken.

(c) After Operation.

As soon as the wound is healed after removal of the breast a course of treatment by the radiologist is now advised in all cases. The hope we entertain is that any cancer cells in the neighbourhood of the wound will be killed, and that recurrence may be so prevented. Of the prophylactic value of the rays we cannot speak with any certainty. A local recurrence after an operation for mammary carcinoma is in any event so rare that a very long series of cases would be necessary to establish the value of post-operative radiation. But, again, on theoretical grounds the treatment appears so rational that I should not feel content to omit it.

It is perhaps desirable to urge once again the necessity for an x-ray examination of the chest and neck before any operation for carcinoma of the breast is undertaken. The search for metastatic deposits in outlying regions should invariably be made before removal of the primary source is undertaken. When recrudescence of the growth has taken place in the neighbourhood of the wound, or when glands appear in the neck, radiation will often produce the most remarkable results. I have known multiple nodules scattered widely over the chest wall to disappear completely, and to remain absent until the patient's death in consequence of visceral deposits; and glands grossly enlarged and causing pain in the neck and head are diminished in size or caused to vanish, and the lancinating pains soon disappear.

(d) Inoperable Cases.

A visit to the radiological department engaged in the treatment of these cases is a depressing experience. Cases for which the surgeon can do nothing, and cases for which he has done all he can, are sent to this last resort. All the surgical outcasts find refuge here. If radiology could do nothing for them no blame could attach to it, for more unpromising derelict material it would be impossible to find. Yet something is wrought upon these cases that at times approaches the miraculous. Growths shrink and wither away, and foul and extensive ulcers make vigorous attempts to heal, and haemorrhage from excavating caverns ceases entirely. Growths of the thyroid seem to melt away, and growth of the parotid, hard, fixed, and painful, may disappear very quickly. But the return is not long delayed. The most dramatic result I have ever seen was in connexion with a carcinoma of the thyroid as large as the patient's head, which disappeared almost entirely within a month, only to return with almost equal haste and quickly to prove fatal. There are, of course, many disappointments, and at present one is not able confidently to reckon upon any improvement in the individual case; but the fight for each one is always worth while.

The effects produced upon the patient are sometimes apt to be serious unless great care is taken. The red cells are so diminished in number that great enfeeblement results. I have many times given one or two transfusions of blood in patients who have to submit to x-ray treatment, and hypodermic injections of iron are administered regularly, and most patients are given artificial sunlight baths.

The gifts of radiology to medicine and to surgery have been most lavishly bestowed. When we consider that this science is a newcomer into the fields of diagnosis, of therapy, and of research, the results obtained in so short a time are surely matters for which humanity at large may feel profoundly thankful. If I may for one moment arrogate to myself a greater authority and a wider responsibility, I should like to offer to you, gentlemen, in the name of all your colleagues, my respectful homage for the immense benefit you and your forerunners have already conferred upon mankind, and to express my confident prediction and my warmest hopes for the continued and beneficent progress of the science which you so worthily represent.

REFERENCE.

¹ *British Journal of Surgery*, 1923, xi, 7.