neutralized it, while that from the rabbit that had received the stationary dose of this same antigen failed to do so.

Fourth Test.

On the third day after the tenth dose the serum of all the rabbits was tested against the weak toxin, but none of the rabbits previously negative was found to be other than negative again. The serum of the rabbits prepared with the following antigens neutralized the toxin:

1. The dried coccus, dose stationary.
2. The dried coccus, dose raised.
3. The sensitized coccus, dose raised.
4. The raw coccus, dose raised.

On testing these serums against the strong toxin, two saved the mice and two failed to do so. The successful serums came from the rabbits prepared respectively with the sensitized coccus and with the dried coccus, both in rising doses. On proceeding to test 0.25 c.cm. of each serum against the strong toxin, neither of them succeeded in saving the mice. Anti-endotoxin, therefore, was far more abundant in the serum of both these rabbits twenty-four hours after receiving the last dose than two days later.

Fifth Test.

On the fifth day after the tenth dose the serums of the two rabbits positive in the last test were re-examined and both found to be negative in 0.5 c.cm.

SUMMARY.

1. Multivalent antimeningococcus serum that has given the best results in military cases has been found to be differentiated from serum of less therapeutic value by the fact that the former contains a demonstrable quantity of anti-endotoxins to each of the two commonest types of the meningococcus.

2. Anti-endotoxin is elaborated by the rabbit to both the commonest types of the meningococcus.

3. In order to obtain anti-endotoxin, especially in the case of Type I meningococcus, it is absolutely essential to avoid over-dosage.

4. The antigens that appear to give best results in the rabbit are neither the raw coccus nor autolysates, but (1) a suspension of the dried coccus, and (2) the sensitized raw coccus.

THE VALUE OF X RAYS IN THE TREATMENT OF MALIGNANT DISEASE OF THE BREAST.*

By CLAUDE SABERTON, M.D.,
HARROGATE.

THE subject matter of this paper is not new, but having had ten years' personal experience in the x-ray treatment of malignant disease, I propose to discuss its value in malignant disease of the breast, for the x-ray treatment of malignant disease in general is too large a subject for a single paper. The cases we are called upon to treat fall into three main groups: (1) Those sent for prophylactic treatment following operation, or (2) for treatment of recurrences, and (3) inoperable cases.

We will consider these groups seriatim.

PROPHYLACTIC TREATMENT.

Patients for prophylactic treatment should be sent to the radiologist as soon as possible after operation. It is essential to administer large doses of x rays, and the rays are measured after filtration through 2 or 3 mm. of aluminium. The scar area, axilla, supraclavicular and post-scapular areas should all be treated. With careful technique these doses can be repeated to the same skin areas once a fortnight. This method of cross fire enables a large quantity of rays to reach the mediastinum. The radiation is greatly facilitated by the introduction of the Coolidge tube. In ordinary cases the first course of treatment lasts about three months. A second shorter course is given after two or three months, and subsequent radiations are administered at gradually lengthening intervals. The patient is kept under observation for two or three years following the date of the operation. During this

time it is important for the physician in charge of the case to administer blood tonics, such as iron, and give advice as to general habits of life, so that the patient's resisting powers may be built up. In some cases the administration of thyroid extract is advisable. Blood counts at intervals are a helpful guide, and last, but not least, I must lay stress on the great help and importance of optimism. The patient needs all her powers and must be cheered and encouraged in the fight.

Results.

Local scar recurrences are rare, but if nodules appear they can with rare exceptions be controlled. I have seen one or two cases in which there was a rapid spread of cutaneous nodules all over the body, probably due to a general infection of the lymphatic system of the skin. When this occurs patients usually succumb rapidly.

Slight enlargement of glands and thickening behind and above the clavicle are fairly common. We are able to prevent gross enlargement of these supraclavicular deposits, and they frequently disappear under vigorous raying. They never break down or ulcerate; I think they are sometimes possibly more of an inflammatory nature than actually malignant, and are perhaps due to some slight septic infection of the wound area. The question arises whether these supraclavicular enlargements are recurrences following the operation, or due to inability to remove infected glands at the time of operation owing to their situation behind the clavicle. Certainly supraclavicular enlargements are much more frequent than axillary deposits. I have never seen ulceration from the breaking down of secondary growths in cases that have had the benefit of an operation followed by intensive x-ray therapy. On the other hand, large foul fungating and ulcerated masses are frequently seen in patients not subjected to radiation.

We are frequently disappointed when all appears to be well, and there is no evidence of any local recurrence or mediastinal deposit, by patients complaining of lumbago or sciatica. It is curious how often one meets with recurrences in the lumbar spine; unfortunately at present all one can hope to do in these cases is to relieve or alleviate pain.

Swelling of the arm from lymphatic obstruction is occasionally a troublesome and distressing sequel of operations, and is most common where it has been necessary to remove a large area of skin. Owing to fixation of the tight cutaneous tissues to the thoracic wall, and the formation of taut bands of scar tissue running along the anterior fold of the axilla, the patient is from the first unable to abduct the arm. This condition materially interferes with the efficient radiation of the armpit. Usually the lymphatic obstruction of the arm gets progressively worse, and the limb sometimes reaches an enormous size. This complication is not so frequent as it was years ago, probably owing to different operative technique, and I have noticed it to be much less common in those cases in which the surgeon has carried the skin incision along the anterior fold of the axilla and not into the axilla.

The general conclusions arrived at from treatment of cases in this group are as follows:

1. The patients are less likely to have a recurrence of the disease than cases not so treated.
2. Local recurrence in the scar area is rare.
3. Supraclavicular deposits do occur, but can as a rule be controlled. These deposits never break down or ulcerate.
4. Mediastinal recurrence appears to be less frequent.
5. The general health of the patient is improved.

In view of these facts every case of scirrhus mammae should be subjected to efficient x-ray therapy as soon as possible after operation.

In slow-growing atrophic scirrhus mammae met with in patients about 50 years of age, cases with perhaps a history of ten to fifteen or more years, it is my experience that operation is not as a general rule advisable even though the growth may be showing signs of activity. I have seen a number of these cases after operation in which the general health has broken down, metastases have almost immediately occurred, and the patient has rapidly gone downhill. These results may be due to the removal of the old natural fibrous wall built around the tumour, and the lowered resistance of the patient following the operation. Unless the surgeon decides to employ

* Read before the Yorkshire Branch of the British Medical Association at Harrogate, July, 1918.

electrothermic coagulation, I think as a general rule this type of growth is best left to the radiologist.

TREATMENT OF RECURRENCES.

Here the question of further operative measures arises. The special circumstance of each case must be considered, but speaking generally, surgeons hesitate to operate upon secondary glandular deposits, and the patients are frequently referred to the radiologist. Much can be done to relieve pain and prevent ulceration by efficient treatment; indeed, in some cases, and frequently when least expected, brilliant results are achieved. Foul ulcerating surfaces heal up, large masses of glands disappear, and a symptomatic cure is obtained.

INOPERABLE GROWTHS.

All inoperable cases should be given the chance of deriving benefit or amelioration of symptoms by *x* ray or radium therapy, and frequently both methods are used. We can never tell beforehand to what extent a patient may respond to radiation. Very often what appear to be the most hopeless cases do best, and vice versa. When patients are already cachectic little can be done beyond giving them some relief from pain. Sometimes those taking morphine are enabled to give it up. The general health and resisting powers are, as in every other disease, all-important factors. An examination of the blood from time to time is a helpful guide in prognosis, and *x*-ray examinations of the thorax for secondary deposits should be made at intervals. Malignant growths are affected by radiation both directly and indirectly. Research has shown that cells in process of rapid division, lymphoid tissue, and the endothelium of the blood vessels are especially vulnerable to radiation. In addition to this direct local action, there is an indirect effect brought about through the reaction of the patient to the rays. In these inoperable cases inefficient treatment is worse than useless—it is dangerous, as small doses stimulate cell growth. The treatment must be pushed in massive doses to the limit, and in some instances beyond the limit, of skin endurance. An important guide, and one that it is necessary to watch carefully, is the amount of constitutional disturbance following this intensive therapy. I have known patients have a temperature of 102° or 103° for weeks following heavy treatment of this nature. I mention this as it is possible to get too great a constitutional reaction. In cases which ultimately succumb to the disease, the end frequently comes rapidly.

Before concluding, I wish to draw attention to two rare conditions which arise as a result of radiation:

1. *Late X-Ray Reaction.*—I have seen three examples of this condition. The skin and subcutaneous tissue become very tough, and assume the appearance of wash-leather and finally slough. This late *x*-ray reaction has occurred only in an area that has had a more than usual heavy bombardment of the rays owing to the dangerous and threatening character of the disease. The curious point is that this reaction develops at a date some weeks or months after the patient has ceased treatment, and is quite different from the ordinary normal erythema or pigmentation following vigorous radiation. This late reaction is very painful and takes a long time to heal. Dr. Finzi called attention to the condition some years ago. In one of the three cases which have come within my experience a large secondary mass in the anterior axillary fold had been vigorously treated with heavily filtered rays. The skin, subcutaneous tissues, and the secondary deposits sloughed away. The disease appeared to be killed in this area, and the patient was in good general health when last seen.

2. *Anaemia.*—I have noticed anaemia develop in about half a dozen inoperable cases, in patients where intensive therapy has been given for a number of years. The primary growth remained quiescent or perhaps shrank, there was no evidence of secondary deposits, and no toxæmia resulting from the cancerous mass. Death apparently occurred from general debility and heart failure. This anaemia, I think, may probably be of the same type as that which sometimes develops in *x*-ray operators, but I have no microscopic evidence to support this view. It is known that *x* rays have a profound effect on the blood.

The general conclusions drawn from the treatment of a large number of inoperable growths are that the *x* rays are of undoubted therapeutic value. Life is frequently

prolonged for years, and the growths are robbed of their most distressing features. Pain is relieved or alleviated, secondarily infected glands can be controlled and prevented from ulcerating—ulcerated surfaces usually heal up and foul discharge ceases. The primary growth often shrivels or remains *in statu quo*. Inoperable growths occasionally become operable. The mental comfort derived by the patient would alone justify the treatment. In some of these cases also surgeons might with advantage employ electrothermic coagulation, but surgical diathermy has up to the present been very little used in this country.

There is perhaps a tendency for men engaged in any particular branch of work to over-estimate its value, but I do not think I have over-stated the case for employment of *x* rays in the treatment of cancer of the breast.

GUNSHOT WOUNDS OF THE KNEE-JOINT AS SEEN AT A BASE HOSPITAL.

BY

H. H. HEPBURN, M.C., TEMP. CAPTAIN R.A.M.C.

In a recent issue of the BRITISH MEDICAL JOURNAL (June 29th, 1918) there appeared a very convincing article on the treatment of gunshot wounds of the knee-joint at a casualty clearing station, illustrating the great advance in technique employed and the gratifying results obtained. As the last word has not yet been written on this much-discussed subject, I feel it advisable to record a corresponding improvement in the results of these cases as seen in the base hospitals in France. Since the cases collected at a base hospital are necessarily drawn from a larger number of casualty clearing stations, and as so much depends upon primary treatment, one will naturally expect to find the figures a little below those of the best casualty clearing station and a little above those of the worst. I have undertaken to summarize fifty consecutive cases of gunshot wound of the knee-joint which have come under my observation since the beginning of the spring activities in March, 1918.

Before proceeding to an analysis of these cases I would like to point out that this series does not include those cases where the synovial membrane was not found to be penetrated, and at the same time to commend the practice of early and complete excision of these non-penetrating wounds, thereby preventing secondary infection of the joint in a large number of cases. It is a rare occurrence to-day at the base to find suppurative in a knee-joint when the notes from a casualty clearing station say "Wound excised, not penetrating." In the early days of the war this was unfortunately common, partly due no doubt to faulty diagnosis, but in a large number of cases probably due to secondary infection of a damaged but non-penetrating synovial membrane.

Of the fifty cases under consideration, twenty-five were complicated by demonstrable bony lesion and twenty-five were not. I shall record them under two headings: (a) with fracture, and (b) without fracture. Unfortunately the details of the primary operation performed are not all at hand. In many cases the notes simply state "wound excised" or "excised and sutured at the casualty clearing station." However, the synovial cavity is definitely stated to have been washed out and closed in twenty-seven cases—fourteen cases in Class A with fracture and thirteen in Class B without fracture. Saline solution is stated to have been employed in six cases, eusol in six, and ether in two. The remainder were not specified. Bipp was introduced into the joint in two cases and flavine in one; all three did well. The foreign bodies were "not found," or "not looked for," at the casualty clearing station in nine cases. Five of these required removal at the base. Of the remainder, one was left embedded in the femur, the other three being very small and the joints all quiescent.

It was found necessary to reopen the joint in nineteen cases out of fifty. Of these, twelve were in Class A with fracture, and seven in Class B without fracture. A partial arthrectomy was performed on one case with extensive loss of the condyles of the femur. Subsequent amputation was necessary in six of the nineteen cases—four in Class A and two in Class B. Of the latter, one was amputated for secondary hæmorrhage from a separate wound. Two patients died from septicaemia, one in each class. Both