Previous Illnesses.—He was born at full time, was bottle-fed, and was not looked upon as a delicate child. When 2 months old he had a slight attack of bronchitis or broncho-pneumonia lasting two weeks, from which he made a full recovery and had no complications. At the age of 7 years he developed measles, and again there were no ill effects. He has suffered from occasional colds in the head and slight rheumatic pains in the wrists in winter, but there is no history of tonsillitis, chorea, or acute rheumatism, and no record of pleurisy. At the age of 12 he slipped off a 4-foot wall to the ground and landed with his knee pressed against his chest. He was at once short of breath, and had pains across the chest which lasted three hours, after which he felt quite well and returned to school the next day. Since measles at the age of 7 he has not missed school attendance.

The family history is not important, the parents being alive and healthy, three brothers alive all healthy, and no deaths in the family have occurred. There is no tuberculous history on either side.

Symptoms on Admission.—Fullness of the abdomen and throbbing of the neck were the obvious symptoms. Occasional pain across the chest and in the left shoulder and slight indigestion were further admitted. No cough was complained of, and no record could be obtained of swelling of the legs.

Condition on Examination.—His height was 5 ft. 1½ in., his weight 7 st. 10 lb. He did not look a robust boy, the complexion being somewhat sallow, but there was no cyanosis and no obvious shortness of breath. Undue venous pulsation was noticed in the neck, especially on the right side. No clubbing of the finger-nails was present and no oedema of the legs. The abdomen was distended by free fluid, the circumference at the umbilicus being 32 inches. The free edge of the liver could be felt three inches below the costal margin, the liver itself feeling smooth but firm. Scanty pubic hair was present, but there was no hair in the axillae. A few small glands were present in the axillae. The teeth were good, the tonsils not enlarged, tongue slightly coated. On July 8th paracentesis was performed, 96 ounces of a clear straw-coloured fluid being withdrawn. Culture was negative, and very few lymphocytes were found on staining. Injection into a guinea-pig had no ill effects on the latter. After withdrawal the lower pole of the spleen was just palpable. No enlarged glands or tuberculous masses could be felt in the abdomen. The chest was hyper-resonant in the upper lobes. The lungs expanded freely. The breath sounds throughout were harsh vesicular in type. No adventitious sounds were heard except a fine friction over the splenic area. The chest was x-rayed on June 26th by Dr. J. Bromley of Stoke-on-Trent, who reported as follows:

"Both diaphragms are raised, doubtless due to the amount of free fluid in the abdomen. There is no marked increase in the extent of the hilum shadow and no impaired air entry into the chest." The urine was free from albumin and sugar, and the urea concentration test was normal. Blood urea did not exceed 13.5 mg. per 100 c.cm. The Wassermann reaction of the blood was negative. A fractional test meal revealed no abnormal features. The levulose tolerance test increased the amount of sugar in the blood from 0.12 to 0.22 per cent., and no sugar was passed in the urine. The blood count on June 26th showed red blood cells 3,700,000, white blood cells 11,500, haemoglobin 75 per cent. Differential count: Polymorphs 80 per cent., lymphocytes 18 per cent., eosinophils 1 per cent. No abnormal cells were found.

Condition of the Heart.—A distinct fullness was observed over the precordium. The apex pulsation was scarcely visible, and there was no indrawing of the interspaces. No thrill was felt on palpation, and the positions of the heart borders and of the apex beat itself were difficult to define by percussion, owing to the hyper-resonant note of the lungs. Careful percussion, however, seemed to locate the apex beat in the fifth interspace about half an inch outside the nipple line. There was a definite epigastric pulsation visible. Auscultation revealed a curious high-pitched musical squeak, which was audible at one time and absent at another. The character of this bruit was very peculiar. On certain occasions it was heard all over the precordium and over the left scapula; at other times it was absent behind. Sometimes it was more marked at rest, sometimes only after exercise. It was at times loudest during deep expiration, and occasionally it would disappear altogether for long spells, during which intervals no valvular disease was apparent. The timing of this sound also varied. Usually it coincided with the closure of the aortic valves, at other times it occurred during ventricular systole. It seemed to have its origin outside the heart itself, and probably depended upon some adhesion between the pericardium and neighbouring structures. The systolic blood pressure was consistently low, the average being 112 mm. of mercury. The pulse rate averaged 90 per minute, and the exercise tolerance test was normal. The electrocardiogram taken both before and after paracentesis showed the constant inversion of T-wave in leads ii and iii. No particular ventricular preponderance was present.

Progress.—After paracentesis on July 8th the boy's health seemed to suffer and a progressive slight loss of weight occurred for a week or two afterwards. With iodide of iron internally and iodoform inunction to the abdomen his health began to improve and he gained weight—some of this increase being due no doubt to a slight return of the ascites. The chest was again x-rayed by Dr. J. Bromley on August 10th, his report being: "There appeared to be some enlargement of the ventricular shadow to the right, while in the left hilum a distinct bulge is seen, suggesting an enlarged clump of glands. Both diaphragms moved well at this examination." A further blood count was performed on August 22nd, which showed the improvement which had occurred—namely: red blood cells 5,500,000, white blood cells 16,500, haemoglobin 85 per cent. Differential count: Polymorphs 78 per cent., transi-

tional and mononuclears 4 per cent., lymphocytes 16 per cent., eosinophils 1 per cent., basophils 1 per cent. No abnormal red cells were found.

He was discharged on September 1st in good condition, and when re-examined on November 4th, 1928, he looked plump and well, but ascites had largely accumulated again and a very slight oedema of the legs was found. His weight was 8 st. 3 lb., and there was no apparent shortness of breath or distress on exertion. Further paracentesis will shortly be necessary.

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INOPERABLE CARCINOMA OF THE BREAST TREATED WITH RADIUM.

BY

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In considering the radium treatment of carcinoma of the breast it must be remembered that both external applicators and needles are employed. The apparatus must be screened in such fashion as to cut off the beta rays, which are harmful to the tissues, and permit the gamma radiation to pass; 2 mm. of lead is recommended for external plaques when prolonged exposures are contemplated. A compound known as "Columbia wax" is most useful when treating a large surface area. For slow-growing tumours needles with walls of 0.5 mm. of platinum are recommended; these vary in active length from 1 to 5 cm., and contain 0.5 mg. of radium element to each centimetre. More recently tiny needles known as "seeds" have been found to be useful in some cases. The most convenient seed is one containing 2 millicuries of radon and screened through 0.5 mm. of platinum or gold. In cases of encephaloid character, where the growth is extremely rapid and very vascular, more powerful needles, screened through 1 mm. of silver, are often of great value.

REVIEW OF CASES.

An attempt has been made to ascertain the fate of the 633 patients suffering from breast carcinoma who have been treated at the Radium Institute during the last ten years. A study of these cases has not only made it possible to form an opinion as to the value of radium therapy in hopeless cases, but from the information obtained certain principles can be formulated for the treatment of patients in whom the disease is less advanced. In the series under review, which does not include patients who received prophylactic treatment, it was found that in every case the disease had extended to tissues outside the breast itself.

TABLE I.—Showing Type of Cases and Site of Metastases.

	Total No. of Cases.	Primary Inoper- able Cases.	Recur- rent Cases	Axillary Glands.	Supra- clavi- cular Glands	Chest Wall.	Ulcera- tion.	Oedema of Arm.
1918	82	16	66	43	44	25	4	11
1919	88	21	67	39	45	21	4	10
1920	81	29	52	31	33	33	10	19
1921	69	16	53	31	29	32	11	12
1922	41	6	35	19	23	15	6	5
1923	44	10	34	23	11	11	12	5
1924	39	12	27	23	16	13	3	10
1925	66	15	51	36	34	25	11	10
1926	58	21	37	24	27	21	8	11
1927	65	18	47	31	34	25	14	12
	633	164	469	300	290	223	83	105

TABLE II.—Showing Prolongation of Life from Date of First Treatment.

	No. of Cases.	Alive at 10 Years.	Alive at 5 Years.	Alive at 3 Years.	Total Surviving 3 Years or More.	Improved Markedly.	Not Improved.
1918	82	5	3	10	18	37	15
1919	88	—	13	12	25	31	21
1920	81	—	10	5	15	23	7
1921	69	—	13	7	20	32	9
1922	41	—	3	6	9	18	7
1923	44	—	4	2	6	16	8
1924	39	—	—	5	5	22	10
1925	65	—	—	14	14	19	12
	510	5	46	61	112	198	90

Summary of Results.—Of 510 cases (1918-25), 112 were alive at the end of three years=22 per cent. Of 405 cases (1918-23), 51 were alive at the end of five years=12.6 per cent. Of 82 cases (1918), 5 were alive at the end of ten years=6.1 per cent. All those patients on whom a recent report has not been received have been regarded as having died at the date of the last report.

CONCLUSIONS.

Not only are the results given above very encouraging, but a large number of patients (about 40 per cent.) showed marked temporary benefit, even though they succumbed within three years of treatment. Most of the cases were too advanced to offer any hope of cure, but much was done to relieve suffering and control the progress of the disease. Distressing symptoms were often alleviated, and in many cases life was prolonged for a considerable number of years. Ulcerations were healed or prevented, thereby relieving the patient of a good deal of pain. Cutaneous nodules disappeared, while large swellings became smaller and less fixed, often regressing to such an extent that only a residual thickening could be felt. Relief was often obtained even in cases where there was marked lymphatic obstruction with oedema of the arm, the limb becoming less swollen and more movable.

It must be remembered that the above series represents pioneer work in the radium treatment of breast cancer. A review of cases treated during the past three years promises to show more favourable results. This is due to the fact that patients are being sent for treatment at a less advanced stage, and also to the advances made in technique during the last three years.

SOME GENERAL CONSIDERATIONS IN THE TREATMENT OF CARCINOMA OF THE BREAST.

Cases may be classified into three groups: early operable, late operable, and inoperable.

Early Operable.—Although the logical conclusion is that radium therapy is competent by itself to deal with very early cases of carcinoma of the breast, it has yet to be shown that radium treatment alone can give as good results as operation. When the growth is still confined to the breast, and there are no palpable axillary glands, operation has given good results. Statistics published by the Ministry of Health show that operation will keep 73 per cent. alive for ten years. In this class of case radium treatment must not be regarded as a substitute for operation at present, but much may be accomplished by using radium as an adjunct to surgery. Striking results have been obtained by Mr. Geoffrey Keynes in cases of carcinoma which are technically operable; but at present his cases are too recent to justify any positive deductions, and it remains to be seen whether the ultimate results of the treatment are as good as those of surgery.

Late Operable.—This is a group of cases which requires careful consideration. The disease is no longer confined to the breast itself, but is still considered technically operable by all but the most conservative surgeons. Of the 633 patients treated at the Radium Institute between 1918 and 1928 74 per cent. were recurrent cases following amputation of the breast. Of these cases 290 (46 per cent.) had palpable supraclavicular glands. The fact that a large pro-

portion of these metastases became evident within six months from the date of operation shows that a much more conservative judgement is required in deciding whether a breast cancer is operable. This is a most important point. Of these "late operable" patients few are cured, and some are made worse by operation. An area containing cancer cells is opened up by unsuccessful surgery, and this acts as a stimulus to the growth. When a recurrence appears the axilla soon becomes filled with a fixed mass of disease. There is much scarring and fibrous tissue formation, the blood supply is poor, and there is little or no surrounding healthy tissue. Subsequent radium treatment is undertaken at a great disadvantage, and with less chance of success than if radium had been employed without any previous operation.

Inoperable.—Inoperable and recurrent cases, in which a radical operation is out of the question, have been considered above. This class of case is often greatly benefited by radium treatment. Some surgeons remove as much of the growth as possible, and then pack the wound with radium. Experience has shown that this is frequently a disastrous procedure. Metastases in the supraclavicular region should be treated with radium alone, since the results following excision do not encourage operative intervention.

The Primary Growth.

The treatment should be such as to cause the growth to disappear with little or no tissue necrosis. The amount of radium required, the intensity of the dose, the filtration, and the time of exposure vary to some extent with the nature and extent of the neoplasm. Scirrhus growths require needles of low content heavily screened and left *in situ* for a comparatively long time, about a week. When an ulcer exists the needles should be introduced into the healthy tissue in the immediate vicinity of the growth. Isolated subcutaneous nodules are best treated with platinum or gold seeds containing radon. Retrogression usually occurs much more slowly in scirrhus growths than in highly cellular tumours. The reason for this probably lies in the comparative avascularity of scirrhus lesions. Large doses of radium, especially if lightly screened, may cause necrosis and sloughing. Encephaloid tumours, apart from being more cellular, are more vascular. Rapidly growing tumours are more susceptible to irradiation, and respond more dramatically than the scirrhus growths. They require a large dose for a comparatively short time, three or four days, and the needles need not be so heavily screened. Severe systemic disturbance often occurs in the course of the treatment of such cases, owing probably to the absorption of products of disintegration, and a very remarkable degree of shrinkage is often seen at the end of a fortnight or three weeks after irradiation. The treatment of the primary growth should be supplemented by the application of an external plaque, but it is inadvisable to employ this when the needles are *in situ*.

The Associated Lymphatic Areas.

Just as in the surgical treatment of carcinoma of the breast it is not enough to do a local amputation, so in the radium treatment it is insufficient to treat only the primary growth, even if there are no palpable glands. The treatment should be directed on the same lines, by a thorough irradiation of the chest, concentrating on the associated lymphatic areas, and those areas in which metastases and recurrences are most likely to appear. (See Table I.) Mr. Geoffrey Keynes in his technique irradiates these areas by inserting radium needles of low content in the axilla, above and below the clavicle, and at the sternal ends of the first three or four intercostal spaces. Mr. Sampson Handley treats these areas by burying very powerful needles in similar situations for much shorter periods, and if the case is operable he performs a complete amputation of the breast at the same time. Mr. Handley believes that breast cancer when it comes to operation is already an intra-thoracic disease. Although the needles inserted in these areas have prevented metastases occurring in Mr. Keynes's series the rational treatment appears to be to treat the chest more thoroughly. The area to be irradiated must be a wide one, and is best treated by the external application of large quantities of radium over a comparatively long period, concentrating on these particular areas. Apart

from the fact that a more thorough irradiation of the mediastinum is obtained there is no risk of necrosis of cartilage or bone, which may occur even with needles of low content buried in the near vicinity of these tissues. Heavy filtration is necessary—2 mm. of lead or its equivalent should be employed. Large doses must be given at a minimum distance of 15 mm. from the skin surface.

External application of radium has been discouraged as unsuccessful mainly by those who have not had sufficient quantities at their disposal, for inadequate doses of radium have been responsible for many so-called failures. External irradiation, however, has a very definite place in radium therapy, although it must be remembered that the skin is very sensitive and is easily damaged by rays which are insufficiently screened. In this country Mr. Stanford Cade has shown that the skin can be subjected to enormous doses in the "collar treatment" of secondary cervical glands by using heavily screened radium applied to a mould of "Columbia wax." The superficial layers of the skin peel off, but the skin heals rapidly, leaving a soft pigmented scarred surface, but no contraction. This effect on the skin must be caused by the continuous gamma radiation, which has this effect only when employed for long periods.

Pre- and Post-operative Radium Therapy.

This is still a matter for a great deal of investigation. It has been impossible to form any opinion as to its value from the study of cases treated at the Radium Institute, but there are reasons for supposing that many recurrences might be prevented if pre- and post-operative irradiation were more often employed. Statistics have been published to show that in patients who have had pre- and post-operative irradiation the outlook is better than in cases treated by surgical means alone. It has been erroneously stated that pre-operative radium treatment causes delay in healing, and affects the tissues in such a way as to make operation more difficult. Microscopical sections of irradiated tumours tend to show that it is unnecessary to postpone subsequent operation for more than a fortnight.

There is no doubt that recurrences appearing after prophylactic irradiation are very refractory to further irradiation. Similarly it is found that a second treatment of any neoplasm is less effective than the primary treatment. For this reason the first treatment should always be as thorough and vigorous as possible. If a second treatment is necessary the dose must be relatively smaller.

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THE EFFECTS OF ANAESTHESIA, OPERATION, AND CERTAIN OTHER FACTORS ON GLYCAEMIA.

A PRELIMINARY INVESTIGATION.

BY

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THE administration of glucose is an accepted procedure in the treatment of post-operative shock. The value of this treatment is now questioned, since it has been reported that hyperglycaemia occurs after operation. This investigation was undertaken to determine the effect upon the blood sugar of a surgical operation carried out under routine conditions, and to ascertain the factors which influenced any changes observed. The action of the administration of rectal and subcutaneous glucose salines was studied.

Investigation Carried Out.

Observations were made on patients who had been admitted to the wards and who all had the routine preparation, except in those cases admitted as emergencies for immediate operation. The last meal was on the evening

before operation, but the patient received a cup of tea early the next morning. Purging of the patient was restricted to a small dose of castor oil on the day previous to, and an enema on, the morning of operation.

In most cases the blood sugar was estimated before operation, and on many occasions after the commencement of the operation. In several cases the blood sugar was estimated again some days after operation under conditions similar to those which obtained on the day of operation, but, of course, without the mental strain which operation entails. In addition to the investigation of the blood sugar, patients have had a record of the pulse rate taken at corresponding intervals of time, and these readings have been graphed along with the blood sugar curve. In all cases we have noted: (1) The history of the illness, attention being especially directed to any points which might be suggestive of sepsis or of diabetes. (2) The general condition of the patient, especially any degree of shock or constitutional disturbance. (3) The nature and duration of the anaesthetic, together with the time and dose of any drugs administered.

Method.

Samples of venous blood were taken from the patients at various times. The estimations of the blood sugar were made by means of the Benedict picric method,¹ which allows of some delay between the obtaining of the sample and the carrying out of the estimation. The estimations which involved the comparison of fine degrees of colour were undertaken by one of us (E. M.) to avoid possible individual variation. Seventy-seven cases have been investigated and have been analysed.

Pre-operative Level of the Blood Sugar.

The average level of the blood sugar in a fasting healthy adult when estimated by this method is 120 mg. per cent.² In all our cases we examined the blood sugar before operation to enable us to establish a standard for each patient, and we found that the pre-operative level of the blood sugar varied considerably. The highest level which we have observed has been 227 mg. per cent., while the lowest level in our series was 84 mg. per cent.; the average reading obtained from the 73 cases analysed was found to be 124.3 mg. per cent. According to Pierce and Scott,³ who used MacLean's method of blood sugar estimation, the normal level of the blood sugar in a healthy adult lies between 95 and 99 mg. per cent. In view of these figures and the figures of Levi⁴ and Miss Potter⁵ (to which reference will subsequently be made), it seems to be a fair conclusion that there is a phase of hyperglycaemia before operation. An analysis of our cases suggests that the condition from which the patient was suffering had a considerable influence upon the level of the blood sugar.

We made a special analysis of those cases where the pre-operative level of the blood sugar was above the recognized maximum in normal people (160 mg. per cent.).⁶ We found that out of the 57 cases operated on under general anaesthesia 13 were above this high level of glycaemia, and averaged 184 mg. per cent. Of these 13 cases 9 were admitted as emergency cases—3 being duodenal perforations and 4 acute appendicitis.

The effect of various conditions is also borne out by Table I. We conclude that three factors are demonstrated

TABLE I.—*Pre-operative Blood Sugar in Various Conditions.*

Condition.	Cases.	Average Pre-operative Blood Sugar.
		mg. per cent.
Hernia and hydrocele	9	114.1
Acute appendicitis localized—that is, acute infection	12	137.0
Shock: fractured femur (2), concussion, strangulated hernia	4	160.5
General peritoneal infection: perforated duodenal ulcer (4), appendicitis	5	185.4
Various cases in which there was a well-marked focus of chronic sepsis	7	114.4
Various cases in which no obvious sepsis was noted	17	122.3

to bear influence on the glycaemia: (1) acute infection, (2) surgical shock, (3) peritoneal irritation. Nervousness is a factor in pre-operative hyperglycaemia, since such