

MEDICAL USES OF RADIUM.

---1931

**Privy Council**

**MEDICAL RESEARCH  
COUNCIL**

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**MEDICAL USES OF RADIUM**

**Summary of Reports from Research  
Centres for 1931**



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## PREFACE

THIS Report summarizes the results of research work done during 1931 in the treatment of cancer by means of radium lent by the Medical Research Council to selected centres throughout the country. It thus continues the account given in the nine similar reports already published (Nos. 62, 90, 102, 112, 116, 126, 144, 150, and 160 in this Series). The scheme of work is under the direction of the Radiology Committee, to whom the Council are indebted for the preparation of these reports.

The original stock of radium salt entrusted to the Council for this purpose by H.M. Government is supplemented by further quantities provided by the British Empire Cancer Campaign and by the National Radium Commission. Support has also again been given by the Campaign to the Radon Centre maintained by the Council at the Middlesex Hospital for the supply of radium emanation. The Council would here once more express their high appreciation of the continued co-operation of these bodies.

The Report not only deals with the actual work of the past year, but also gives statistical data relating to the after-histories of patients treated in earlier years. It contains, further, a new section in which some account of purely experimental investigations is presented. The scope of the experimental work has been extended in important directions by help of the recent augmentation by the Radium Commission of the quantity of salt available to the Council.

MEDICAL RESEARCH COUNCIL,  
38 Old Queen Street,  
Westminster, S.W. 1.

*7th October 1932.*

# MEDICAL USES OF RADIUM

Summary of Reports from Research Centres for 1931.

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## INTRODUCTION

THE Radium Report for the year under review, 1931, is divided into three sections: (1) Clinical, (2) Statistical, and (3) Experimental. Thanks to the action of the Radium Commission in putting one gramme of radium at the disposal of the Council for experimental purposes, it has been possible to increase the facilities at several Centres and to start other lines of research. Owing to the part which these lines of experimental work are likely to play in radium-therapy in future, they have been given somewhat detailed consideration here.

The clinical sections of the Reports give indisputable evidence that the main lines of radium-therapy at the present time are the treatment of cancer of the breast, buccal cavity, and cervix uteri, and the exploration of new lines of technique. These have been commented upon in previous Reports, but even now it can hardly be said that any one method has yet been devised and tested which gives the fullest scope to radiological methods. The three sites in question illustrate very well the stages in the development of a method. There is a large majority of opinion that the best radiological method for healing cancer of the cervix uteri consists in a local

application of radium to the cervix and the lateral fornices, supplemented at a later stage by gamma or X-rays applied externally.

In the treatment of buccal cancer the most difficult problem appears to be in growths of the tongue, with the all too frequent extensions to the glands in the neck. The method of to-day has advanced to the stage where nearly all primary growths in the tongue are treated by means of radium or radon needles inserted directly into the affected tissues, but for the best method of dealing with the glands there is still a conflict of opinion. The fact as it is revealed statistically is that the expectation of life of a patient with a primary growth of the tongue which has extended to the glands in the neck is still very low, and this in spite of at least three methods of treatment which have been devised for dealing with this condition: (1) operation followed by irradiation, (2) radium followed by operation, (3) surface gamma or X-rays. It is in some respects surprising that although the glands are often operable and though the field of irradiation is not necessarily very extensive, the end results are so disappointing. It is, perhaps, significant that glands of the neck are in the region of some of the most vital structures of the body, and a general lowering of the physiological tone may have a far-reaching influence on the powers of recovery. A comparison between radium and surgery is hardly relevant, for present-day therapy consists very largely of a combination of surgical and radiological methods; it can, however, be said that excision of the tongue has given place to radium treatment.

In breast cancer the method originated by Keynes has been adopted in its general principles by several of the Centres. The common experience is that the operation mortality is very low, but the results which have been returned so far in these annual Reports give the impression either that the expectation of dealing successfully with inoperable breast cancer should not be pitched too high, or that radiological methods for this site have at present been only partially explored. Admittedly the spread of the disease at this site is a more formidable problem for either surgeon or radiologist than in the other two sites which have just been discussed, and it may be that the radio-therapist will have to bide his time until experimentalists give a hopeful lead in questions of radio-sensitiveness and radio-resistance.

From the experimental side the Reports show that not only is there an increasing amount of purely experimental work being done on radiological lines, but that studies are at last being undertaken of a fundamental physiological character. These may not quickly provide the answers to the problems of the clinic, but they must inevitably broaden the basis on which the general principles of radio-therapy are being laid.

In last year's report data were collected from various centres on the relative frequency of surgical and radiological treatment for patients suffering from malignant disease. The total figures in the returns referred to did not number more than just over a thousand and no certain conclusions could in consequence be drawn from them. This year returns of this character have been made from the following

hospitals, none of them, it will be noticed, being institutions specializing in radium treatment: Aberdeen, Birmingham, Cardiff, Dublin, Middlesex Hospital, St. Bartholomew's Hospital, St. George's Hospital, St. Mark's Hospital, St. Peter's Hospital, and the Royal Free Hospital.

The data are collected in Table 1 and it may be fairly concluded that the relative frequency of surgical and radiological treatment for patients suffering from malignant disease and attending the Research Centres is about equal. This is an indication of the rapid development of radiotherapy, since this form of treatment was, until very recent years, in its infancy in this country.

TABLE 1

	<i>Number treated (1931).</i>	<i>Percentage of total number treated.</i>
By all methods . . . .	2,333	100.0
By surgery alone . . . .	758	32.5
By radium alone . . . .	761	32.6
By X-rays alone . . . .	255	10.9
By surgery + radium . . . .	225	9.6
By surgery + X-rays . . . .	181	7.8
By radium + X-rays . . . .	119	5.1
By surgery + radium + X-rays	34	1.5

It is not possible to include in the table the total number of cases of malignant disease seen in the year 1931 as some Centres have been unable to provide the data.

These bare figures in themselves give no information about the relative frequency of radium and radon treatment. In 1925 the Council, with the generous support of the British Empire Cancer Campaign, formed a Radon Centre at the Middlesex Hospital for the express purpose of facilitating the development of radon technique. These facilities were reserved for the Research Centres without charge to them and have been shared by most of them. The Chart in Fig. 1 shows the number of requisitions which have been dealt with at this Centre since its formation.

It will be observed that the last few years have seen an increase in these numbers in spite of the fact that two of the Research Centres, viz. St. Bartholomew's Hospital and the London Hospital, have provided radon installations for their own needs. The conclusion would therefore appear to be that this particular technique is being developed on a considerable scale, and this in spite of the fact that all radon supplies inevitably decay with a half-time period of 3.85 days. It is therefore impossible exactly to duplicate a radium dose by a radon dose, for if the initial intensities are the same the radon must be used for a comparatively longer time, thus introducing a variable time factor, and on the other hand if this variable is to be avoided the initial intensity of the radon must be increased, thus bringing into play another variable, the intensity factor. In face of these complexities one has to find a reason to account for the fact

that the technique is one which is largely used, and perhaps the most outstanding feature of this technique is the adaptability it allows in the form of the radio-active source. The so-called 'seeds' enclosed in platinum or gold can be very much smaller than a radium tube, so small in fact that in many cases they may be left *in situ* with safety to the patient. This avoids a further operation which is occasionally called for when radium itself is used in the treatment of regions of the body particularly difficult of access.

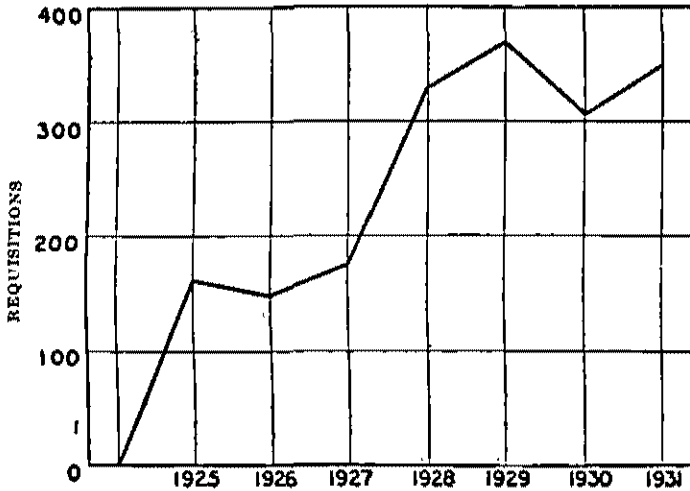


FIG. 1

The report from University College has already been published *in extenso* under the following title: 'Report on Radiotherapy for 1931', by John Bale, Sons & Danielsson, Ltd., and that of the Irish Radium Committee in the Scientific Proceedings of the Royal Dublin Society, vol. 20, no. 21.

In order to facilitate reference in this Report to the work of the individual Centres, they are dealt with alphabetically throughout the Sections A, B, C . . . F.

## A. CANCER OF THE BREAST

### CURRENT TECHNIQUE.

The ABERDEEN ROYAL INFIRMARY reports as follows on the treatment of cancer of the breast:

Wherever possible and suitable a three-stage course of treatment is given, namely:

- (1) Interstitial irradiation of breast and lymph areas (modified Keynes technique).
- (2) Local or radical amputation of the breast.
- (3) Surface irradiation of field of operation adjoining lymph areas.

The interval between the first two stages is never less than six weeks. Each breast specimen is examined histologically. Inoperable cases undergo courses (1) and (3) only. Particular attention is being paid to give extensive surface irradiation to all cases of carcinoma of the breast whatever the nature of the previous stage of treatment.



The report from the **CARDIFF ROYAL INFIRMARY** states that radical amputation is still the routine method adopted for the treatment of operable cancer of the breast. In about half the cases such treatment is supplemented by the application of radium either interstitially or as a surface plaque to the operation area.

During the year under review 6 cases have been treated solely with radium. Two of these were border-line cases, another case was inoperable owing to poor general condition, and 3 were locally inoperable. In each case the radium was applied interstitially to the breast and to the lymphatic areas. Needles 4 to 6 cm. long, each containing 2 or 3 mg. of radium, were inserted uniformly throughout the breast. The total quantity of radium used to cover the whole region was usually 80 to 90 mg., which was left *in situ* for about 10 days. The two border-line cases are now free from any evidence of disease. Another case which had a removable growth, but which was inoperable owing to poor general condition, also shows no evidence of disease.

The report also says:

Radium therapy is of particular service in the treatment of post-operative recurrences of breast cancer. 34 cases have attended the hospital during the last 19 months. In 4 instances the secondary deposit was in a situation where surgical removal was possible, but in 26 cases X-rays or radium were the only alternative methods of treatment. These cases were all treated with radium, which was usually applied as a plaque. 5 cases now show no clinical evidence of carcinoma, and another 10 cases have shown considerable improvement, and great though temporary relief of pain has followed in cases of referred pain from supraclavicular glandular deposits.

**KING'S COLLEGE HOSPITAL** reports on 10 cases of cancer of the breast treated during the year, consisting of 3 very advanced cases, beyond surgical treatment; 3 cases treated by local excision of the breast and radium therapy to the glands; 1 case of recurrence and 3 cases treated by radical amputation of the breast and removal of the axillary glands, followed by a prophylactic surface application of radium.

The **MARIE CURIE HOSPITAL** has continued to use the technique for the treatment of cancer of the breast which was described fully in last year's Report. Operable cases have been treated by radical operation when the general condition of the patient was satisfactory, but during the year 18 primary growths (3 of which were operable but unsuitable for operation) and 11 recurrences after operation have been treated by radium at this Hospital.

The **MIDDLESEX HOSPITAL** report states that:

In the treatment of primary carcinoma of the breast the technique employed for the majority of cases has been the same as in previous years, i.e. insertion of radium (or radon) needles. During the latter part of 1931 some suitable cases were treated by the insertion of needles deep to the tumour and by surface application on a moulded columbia paste applicator.

The **ROYAL FREE HOSPITAL** reports as follows on the treatment of carcinoma of the breast during 1931:

*Primary carcinoma of the breast.*

These cases have been treated by

- (a) radium only,
- or (b) radium followed by local amputation,
- or (c) radical operation and radium.

(a) *Radium only.* The general lines of Keynes technique is followed.

(b) *Radium followed by local amputation.* In such cases as are considered suitable, namely, those in which a large fibrous mass remains, a local excision of the tumour is performed about 6 weeks after irradiation. (In one case of duct carcinoma local excision was performed, followed by surface radiation.)

(c) *Radical operation and radium.* In technically operable cases a radical amputation is performed and needles are inserted, either at the time of operation or within two weeks, in the intercostal spaces and supraclavicular regions.

*Recurrences following radical operation.*

Recurrences in the scar of the operation or in the axillary or supraclavicular regions are treated by surface radiation.

ST. BARTHOLOMEW'S HOSPITAL reports on 93 cases of primary carcinoma of the breast treated during 1931. Of these 90 were operable and 3 inoperable. Twenty-two were treated by the insertion of radium needles according to their usual technique, and the remaining 11 by irradiation following on excision either local or radical. In all except one of these cases an interval of at least 10 days was allowed to elapse between excision and irradiation, so that the wound had completely healed before the needles were inserted. In the remaining case the diagnosis was doubtful but was confirmed by excising the affected portion of the breast with the diathermy needle. Radium was inserted immediately and the wound healed extremely slowly. The report states: 'This corroborates our experience in 1930, and we must conclude that the immediate insertion of radium needles into an operation wound does more harm than good.'

At ST. GEORGE'S HOSPITAL the method of treatment for operable cases of carcinoma of the breast has been radium plus radical amputation, for inoperable cases either radium only or radium plus local operation, and for recurrences radium only. In small recurrences small plaques were used, usually with a 0.2 or 0.3 mm. brass screen, but where there was a multiplicity of nodules or where a large ulcer was present, needles were applied on a pad of sorbo rubber about 1 cm. thick, every alternate 12 hours. Intermittent surface irradiation has been found to give very much greater freedom from severe skin reactions.

The SCOTTISH ASSOCIATIONS OF THE MEDICAL WOMEN'S FEDERATION report upon 11 cases of cancer of the breast treated during the year. Five of these were primary cases and 6 recurrent. Of the 5 primary cases, 2 were treated by interstitial radon in the breast and axilla and 3 by excision and radon in the axilla. They were all alive at the end of the year. Of the 6 recurrent cases, 4 received both interstitial and surface therapy, 1 interstitial treatment only, and 1 surface therapy only. They were all alive at the end of the year except the last-mentioned case.

The report from UNIVERSITY COLLEGE HOSPITAL contains the following description of the methods of treatment of carcinoma of the breast:

All cases of operable primary carcinoma of the breast are treated by radical operation unless this is contra-indicated by age or intercurrent disease. Prophylactic irradiation with X-rays is sometimes given before and/or after operation. Border-line cases are treated by a combination of operation and irradiation, the details depending on the nature of the case, e.g., radical removal of the breast and axillary glands with interstitial irradiation of the posterior triangle of the neck.

Irradiation alone is used in the following types of case:

- (1) Operable primary tumours in which operation is contra-indicated and inoperable primary tumours.  
Method: Interstitial irradiation or X-rays, or a combination of the two methods.
- (2) Local recurrence.  
Method: Interstitial irradiation for small localized recurrences, surface irradiation or X-rays for multiple or diffuse recurrences.
- (3) Metastases in soft tissues.  
Method: Interstitial or surface irradiation or X-rays, or a combination of these methods.
- (4) Skeletal metastases.  
Method: X-rays.

The details of the techniques employed in treatment with radium are as follows:

(1) *Interstitial irradiation for primary carcinoma.* The whole tumour, the surrounding deep fascia and the axilla are irradiated with needles of low linear intensity, which are left *in situ* for 7 to 10 days. If the tumour is massive the needles are placed in two planes, superficially and deep. For smaller tumours the needles are inserted on the deep aspect only. It is sometimes necessary in addition to irradiate the posterior triangle. The longest needles available are used wherever possible, as with them it is easier to obtain even distribution of radiation. The amount of radium used depends on the size of the region to be irradiated, the maximum being about 100 mg. The needles are inserted under general anaesthesia. Smearing the skin with vaseline seems to diminish the cutaneous reaction.

(2) *Interstitial irradiation for recurrence or metastases.* The actual recurrence and a wide zone of surrounding skin are under-run with needles of low linear intensity, which are left in for from 7 to 10 days. For glandular metastases, the whole group in which the metastasis occurs is irradiated. Metastasis in the opposite breast is submitted to radical irradiation as for primary carcinoma. Irradiation for small recurrences is done under local anaesthesia, for large recurrences or glands under general anaesthesia.

(3) *Surface irradiation* is carried out with radium mounted on applicators of Columbia paste moulded to fit the area to be irradiated. Needles of low linear intensity are mounted on an applicator of 1.5 cm. thickness or needles of high linear intensity on an applicator of 3 cm. thickness. In the former case the needles are placed about 1.5 cm. apart, in the latter up to 8 cm. apart. The edge of the applicator is reinforced with a binding of plaster of Paris bandage which preserves its shape; its inner surface is lined with lint. For the treatment with needles of high intensity a continuous sheet of Columbia paste 1.5 cm. thick is moulded to the part and on this sheet are fixed small blocks of paste also 1.5 cm. thick to carry the radium needles. By this device the weight of the applicator is considerably reduced, making the treatment less tedious for the patient. The duration of the treatment is about two hundred hours, given continuously if the patient can tolerate it, otherwise given intermittently. The skin is smeared with vaseline during treatment. The reaction to this treatment is a very intense erythema which varies considerably in the time of its appearance. The erythema is followed by dry desquamation and pigmentation; in a few cases patches of moist peeling have occurred, but these have rapidly healed. Multiple skin nodules disappear rapidly under this treatment, but unfortunately usually recur elsewhere.

Eleven cases of cancer of the breast have been treated at this hospital during the year under review. In 7 cases the result is

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satisfactory, 3 are too recent to be reported upon, and 1 case, with a very extensive inoperable growth, died 7 months after treatment.

## STATISTICAL DATA.

TABLE 2.

	Year.	Primary.		Recurrent.	
		Living.	Dead.	Living.	Dead.
Middlesex Hospital . . .	1925	0	2	1	16
	1926	0	4	1	18
	1927	0	1	0	13
	1928	5	7	2	17
	1929	4	12	0	17
	1930	11	9	7	9
	1931	10	5	5	0
St. Bartholomew's Hospital	1925	1	5		
	1926	1	5		
	1927	7	6		
	1928	16	24		
	1929	38	16		
	1930	28	8		
	1931	33	0		
Marie Curie Hospital . . .	1926	0	1	3	0
	1927	0	0	1	0
	1928	0	1	1	3
	1929	3	6	3	4
	1930	9	4	9	1
	1931	15	3	11	0
University College Hospital	1925	0	1	0	0
	1926	0	1	0	0
	1927	0	0	0	2
	1928	0	1	0	2
	1929	2	3	0	8
	1930	4	4	8	7
	1931	5	1	5	0
Royal Free Hospital . . .	1928	0	2	0	3
	1929	11	19	5	17
	1930	14	10	12	1
	1931	16	0	5	0

Table 3 shows the collected results in Table 2.

TABLE 3.

Year.	Primary.		Recurrent.	
	Living.	Dead.	Living.	Dead.
1925 . . . . .	1	8	1	16
1926 . . . . .	1	11	4	18
1927 . . . . .	7	7	1	15
1928 . . . . .	21	35	3	25
1929 . . . . .	58	56	8	46
1930 . . . . .	66	35	36	18
1931 . . . . .	79	9	26	0

## B. CANCER OF THE UTERUS

## (1) Cervix Uteri.

## CURRENT TECHNIQUE.

The report from the ABERDEEN ROYAL INFIRMARY states that at this hospital the Stockholm technique or a modification of it is adopted as local conditions require. A course of deep X-rays is begun usually 6 weeks after the third treatment. In one or two selected cases an intra-abdominal irradiation following treatment of the cervix itself has been performed.

At the GENERAL HOSPITAL, BIRMINGHAM, the radium treatment of cancer of the cervix has been carried on along the general lines indicated in last year's report. The report states that

In view of the somewhat unsatisfactory results which have attended cases in the Stage 1 (League of Nations classification) group, results which might have been improved had certain of these patients been submitted to radical extirpation of the uterus with the pelvic lymphatics, the policy which is now being adopted at this centre is to combine radium and surgical treatment. If the cervical growth is 'operable' it is first irradiated by either the Stockholm or Paris technique, and four weeks later the uterus is removed together with the iliac groups of lymphatic glands. In the unsuccessful cases the fatal result almost without exception has resulted from extension of the growth to the pelvic lymphatics and iliac glands. Even in the 'clinically operable' group, glands are frequently present which cannot be detected except by operation.

The CARDIFF ROYAL INFIRMARY reports on fistula formation among the 254 cases of carcinoma of the cervix treated with radium during the last 10 years. Fistulae have appeared in 22 of these cases, 8.7 per cent. These 22 cases of fistula formation comprise the following varieties: 10 cases of vesico-vaginal fistula, 9 cases of recto-vaginal fistula, and 3 cases of recto-vesico-vaginal fistula. In none of these cases did the fistula form immediately after treatment, so that it is not considered that they can have been due in any way to the radium treatment which had been given. Of the 22 cases, 21 were advanced and inoperable, 3 of them hopelessly so, and 1 was a borderline case.

In the report from DUBLIN the following techniques are mentioned as being in use at some of the hospitals supplied by the Irish Radium Committee:

(1) *The implantation technique* described last year is still used, the only alteration being that two applications, lasting 4 days, with 7 to 10 days' interval between them, have been substituted for a single application lasting 8 days. Whenever possible this is followed up 8 to 10 weeks later by deep X-ray therapy to the entire pelvis.

(2) *Intra-uterine irradiation.* 24-30 millicuries, screened by 2 mm. lead in a thick gum-elastic tube; time of exposure 7.7 days.

(3) *Irradiation of cervix and fornices.* Platinum needles 0.5 mm. and gold needles 0.5 mm. were buried all round the cervix and in lateral fornices. Ten to twelve needles, each containing 1.8 to 2 mc. each, were left in for a period of 7.7 days.

At KING'S COLLEGE HOSPITAL 15 cases of carcinoma of the cervix have been treated during 1931, all by the Stockholm method. Of

these 15 cases, 3 were operable and 12 inoperable. Four of the inoperable cases are now dead, all the remaining cases are alive.

The MARIE CURIE HOSPITAL reports as follows on the treatment of cancer of the cervix during the year under review:

The general principle of technique has remained as described in previous reports, but there have been slight alterations in details of the standard technique. Whereas formerly three plaques each containing 25 mg. of radium were placed in the vaginal vault at the first application and two plaques in the succeeding doses, in the present method three plaques each containing 20 mg. of radium are placed in the vault at all three applications. Two or three intrauterine tubes containing a total of from 50 to 55 mg. of radium extend from the fundus to the external os. The total standard dose is 3,300 mg. element hours in the uterus and 3,960 mg. element hours in the vault of the vagina. The number of applicators and dosage are modified in accordance with the local and general condition of the patient.

Out of 587 cases treated at this Centre, 533 were squamous carcinomata and 42 adeno-carcinomata. In 12 (all advanced) there was no histological examination. In the results obtained by radiotherapy no difference has been observed between squamous and adeno-carcinoma. In an unmarried girl of 18 years old a papillary adeno-carcinoma of the cervix invading the vaginal fornices and the left parametrium was treated by radium followed by supplementary X-rays. She is now, the report states, nearly 2 years later, perfectly well, and there are no signs of cancer.

The MIDDLESEX HOSPITAL reports as follows on the treatment of cancer of the cervix:

All patients treated by radium for epithelioma of the cervix uteri prior to 1931 were treated, as previously reported, by a modification of the Stockholm technique. During the latter part of 1931 deep X-ray was also given to the parametria.

During the year under review one patient was treated by the technique of the Fondation Curie in Paris, and it is planned to continue with this line of treatment in future. The details of this method have been published in previous reports.

ST. BARTHOLOMEW'S HOSPITAL stated, in last year's report, that they had adopted the Paris technique. This year's report says:

With regard to the decision at the end of 1930 to employ the method of surface application of radium on the lines of the Paris technique rather than the interstitial method, considerable difficulty has been experienced in many cases in introducing the colpostat into the vagina in cases of advanced carcinoma of the cervix, and also in introducing the 40 mg. of radium into the uterine cavity. In cases in which this technique has failed, therefore, the old interstitial method has been carried out as before.

It has been decided as far as possible to give deep X-ray therapy as the first treatment in cases of carcinoma of the cervix, so that this may be followed by radium therapy by the vaginal route after an interval of six weeks to three months.

The SCOTTISH ASSOCIATION OF THE MEDICAL WOMEN'S FEDERATION use the same modification of the Stockholm technique as that employed at the Marie Curie Hospital. This former group has only come into the Medical Research Council scheme during the last

year, so that later on it will be possible to make a useful comparison of the results of the same treatment at these two centres.

They report as follows on reactions to radium treatment:

Such reactions as we have seen have been very mild, and most of the patients have been perfectly comfortable as soon as the radium has been removed. In only one case did the temperature rise above 100° F. One case had slight diarrhoea after the second treatment, but this was easily controlled, and three cases had irritation of the bladder with frequency of micturition. Vomiting has fairly often followed the giving of an anaesthetic, but probably not more than would have occurred had the anaesthetic been given for a simple curettage. It is, however, one of the difficulties of the method that the patients usually dread repetition of this sickness at subsequent treatments. Some tolerate the procedure well under scopolamine and morphine, but the loss of their collaboration without the relaxation of general anaesthesia is not always desirable, and we have found that with very careful manipulation it is possible to give a perfectly satisfactory treatment with no anaesthetic or analgesic to the reasonable type of patient. Sometimes nembutal is given before treatment, or after the patient's return to bed to minimize the discomfort of the pack. No patient so treated had any vomiting. None of our patients have had serious late symptoms except one, who had a well-marked cystitis 4 months after treatment, but few of them have yet reached the stage when such reactions might be expected.

At UNIVERSITY COLLEGE HOSPITAL the method of treatment which was described in last year's report has been continued. In the ordinary way the treatment consists of two applications of radium and a course of deep X-ray therapy. If, however, at the first treatment the cervical canal cannot be found a third treatment is given to complete the uterine dose. It has always been possible to find the cervical canal at the second treatment.

The report from this hospital contains the following account of sequelae to radium treatment:

Of the sequelae of irradiation for carcinoma of the cervix by far the most important is proctitis. A mild and transient attack of this complaint is very common although it may be only by direct questions that a history of its symptoms is obtained. More severe and lasting attacks are less common, but when they occur the patient is well aware of the condition and may be made extremely miserable thereby. One such case is reported among the old patients re-admitted this year. It is extremely difficult to avoid producing mild degrees of proctitis if the treatment is adequately carried out, but severe cases are almost certainly due to inadequate precautions to protect the rectum when the vagina is plugged. It is a good plan to make a rectal examination when the plugging has been inserted. If the boxes containing the radium are not palpable the rectum is probably safe. If the boxes are easily palpable the plugging should be removed and replaced with more bulk behind the radium to displace it from the rectum.

Another sequel that may be expected, although it seldom worries the patient, is stenosis or partial obliteration of the vagina. Obliteration of the fornices occurs in nearly every case, so that the remains of the cervix if palpable seems to be at the vault of the vagina without projecting into it. The extent to which stenosis descends below this level seems to depend to some degree on the extent of the disease. If there is extensive involvement of the vagina, there is likely to be extensive obliteration. In one case in which the carcinoma extended to the introitus the whole vagina has been obliterated. At the follow-up clinic it is not uncommon to find light adhesions in the vagina shortly after treatment. These can be easily broken down with the finger during examination without discomfort to the patient. Whether by so doing one can prevent stenosis occurring subsequently I do not know, but it is a good thing to preserve the patency of the vagina as long as possible for purpose of examination.

## STATISTICAL DATA.

TABLE 4.

Centre.	Year.	Interval. since Ir- radiation.	Operable.		Border-line.		Inoperable.	
			Living.	Dead.	Living.	Dead.	Living.	Dead.
		years						
St. Bartholomew's Hospital	1921	10	0	0	1	6	0	11
	1922	9	0	0	0	7	0	11
	1923	8	1	1	0	5	0	10
	1924	7	1	3	0	11	3	16
	1925	6	2	2	0	3	0	21
	1926	5	4	2	1	4	5	17
	1927	4	1	2	2	2	5	16
	1928	3	4	4	2	4	8	13
	1929	2	3	0	2	3	7	11
	1930	1	4	0	5	0	1	0
University Col- lege Hospital	1921	10	0	0	0	5	0	11
	1922	9	0	0	0	1	0	2
	1923	8	1	2	0	3	0	13
	1924	7	1	1	0	8	0	7
	1925	6	2	1	2	6	0	7
	1926	5	0	0	0	3	0	7
	1927	4	1	0	1	4	1	8
	1928	3	2	0	4	8	1	10
	1929	2	3	0	5	3	2	3
	1930	1	4	0	2	3	1	7
Cardiff	1922	9	0	0	0	1	0	6
	1923	8	0	0	0	0	0	19
	1924	7	1	1	0	3	0	12
	1925	6	1	0	0	4	1	23
	1926	5	0	0	0	0	0	27
	1927	4	0	0	1	1	2	15
	1928	3	3	0	2	8	2	18
	1929	2	2	0	2	5	6	24
	1930	1	8	0	14	7	5	18
Birmingham	1922	9	1	0	0	0	0	8
	1923	8	1	0	0	0	0	18
	1924	7	0	0	0	0	0	13
	1925	6	0	0	0	0	3	13
	1926	5	2	0	0	0	2	27
	1927	4	1	0	0	0	1	24
	1928	3	1	0	0	0	1	23
	1929	2	4	8	2	14	2	11
	1930	1	7	2	1	2	1	4
Middlesex Hos- pital	1925	6	0	1	0	1	1	6
	1926	5	0	0	0	1	0	6
	1927	4	2	1	1	2	2	11
	1928	3	1	2	1	7	3	28
	1929	2	1	4	3	5	5	19
	1930	1	2	0	0	3	4	9
Marie Curie Hos- pital	1925	6	0	0	2	1	3	8
	1926	5	2	0	4	3	8	42
	1927	4	1	0	6	3	11	36
	1928	3	7	0	10	7	25	36
	1929	2	4	0	14	3	38	52
	1930	1	6	0	32	0	55	42



Table 5 gives the total number of cases included in Table 4.

TABLE 5.

Year.	Interval since Irradiation.	Operable.		Border-line.		Inoperable.	
		Living.	Dead.	Living.	Dead.	Living.	Dead.
	years.						
1921	10	0	0	1	11	0	22
1922	9	1	0	0	9	0	27
1923	8	3	3	0	8	0	60
1924	7	3	5	0	22	3	48
1925	6	5	4	4	15	8	78
1926	5	8	2	5	11	15	126
1927	4	6	3	11	12	22	110
1928	3	18	6	19	34	40	128
1929	2	17	12	28	33	60	120
1930	1	31	2	54	15	67	80
Totals		92	37	122	170	215	799

## (2) Corpus Uteri.

At the ROYAL INFIRMARY, CARDIFF, 31 cases of carcinoma of the body of the uterus have been treated since 1922 with radium. All these cases were inoperable, but in addition to these, during 1931, 2 cases were treated with radium in association with, or following, hysterectomy. Only 8 of these cases are now living.

The results of the treatment of cancer of the corpus at the MARIE CURIE HOSPITAL since October 1925 are given in Table 6.

TABLE 6.

Year.	Number.	Operable.		Clinically inoperable.		Technically inoperable.		Living December 1931.
		Living.	Dead.	Living.	Dead.	Living.	Dead.	
1925	2	2	0	0	0	0	0	2
3 months								
1926	1	0	0	0	0	0	1	0
1927	4	2	0	1	0	0	1	3
1928	6	2	0	1	1	0	2	3
1929	9	0	0	3	1	3	2	6
1930	12	0	0	5	1	3	3	8
1931	17	1	0	12	2	2	0	15
Total	51	7	0	22	5	8	9	37

At this Centre the following technique is now used for treatment of cancer of the corpus uteri:

A short cylinder of platinum containing 8 mg. Ra. El. is placed in each cornu and in the middle of the uterine cavity two or three tubes in tandem extend the entire length of the body and cervix to the portio vaginalis, the empty cuff of rubber filling the last part of the canal. The cylinders are threaded with wire which is flexible enough to assume any curve and firm enough to keep the radium in place. Plaques placed in the lateral fornices face the cornua. The radium is evenly distributed in all the tubes and is approximately 8 mg. to each 1 cm. of length. The standard intrauterine dose is 74 mg. at the first application and 74 mg.

or 66 mg. subsequently. When the uterine cavity is very large longer tubes may be placed in the cornua and an additional one in tandem. Three applications of 22 hours each are given. The vaginal plaques, which contain 20 mg. each, are applied to the fornices only at the first two treatments and not at the third. Direct irradiation of the external os is avoided on account of the difficulty of a later dilatation if pyometra supervenes.

Fig. 2 shows the radium placed in position for the first and second treatments of cancer of the corpus. The continuous dotted line shows the zone of lethal action. A therapeutic effect extends for a considerable distance beyond this zone. In the third treatment the vaginal applicators are omitted.

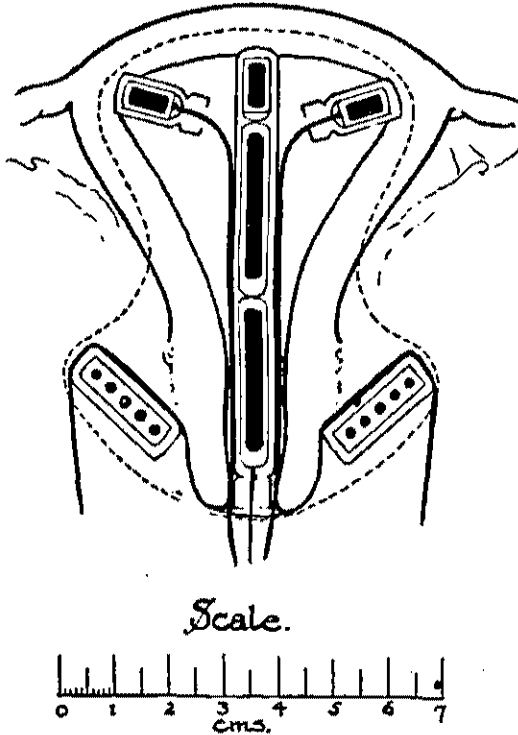


FIG. 2.

The total intrauterine dose varies from 4,000 to 4,880 mg. El. hours. The total vaginal dose is 1,760 mg. El. hours. In the small senile uterus about two-thirds the standard dose is given; the dose is also modified in anaemic cases and in the presence of grave constitutional diseases.

Supplementary deep X-ray treatment is given a fortnight after the radium treatment.

The SCOTTISH ASSOCIATION OF THE MEDICAL WOMEN'S FEDERATION reports as follows on carcinoma of the body of the uterus:

Only 3 cases of carcinoma of the uterine body have been treated, 2 clinically inoperable because of cardiac conditions and 1 technically inoperable. The two first are alive and were well when examined in January 1932. The other has a large growth in the pelvis and hypogastric region for which a course of deep X-ray therapy is being given to supplement the local radium treatment. Her condition is not satisfactory but the severe haemorrhage and pain present before treatment have been relieved.

## C. CANCER OF THE MOUTH, NASO-PHARYNX, LARYNX, AND OESOPHAGUS

### (1) Mouth and Naso-pharynx.

The ROYAL INFIRMARY, ABERDEEN, reports as follows on the treatment of cancer of the buccal cavity:

#### *Mouth.*

(a) Cancer of the tongue proper is treated by interstitial irradiation. A biopsy is done whenever it is justifiable, preferably at the end of irradiation.

(b) Squamous epithelioma of the pillars of the fauces. As a group, cases of squamous epithelioma of the pillars of the fauces, lip, and floor of the mouth were more commonly seen. A few cases of epithelioma of the buccal mucosa were treated.

*Histological classification of tongue* (as against mouth or fauces cases).

(1) Lympho-epithelioma (posterior third of tongue)—1 case.

(2) Typical squamous epithelioma—2 cases.

(3) Anaplastic squamous epithelioma—1 case.

Another case where a biopsy was done after irradiation showed 'no histological evidence of tumour' though clinical appearances were typical prior to irradiation. Thus, comparatively few lesions of the tongue proper were seen and treated. Extensions to the tongue from either the floor of the mouth or the pillar of the fauces were more common.

*Naso-pharynx.* One case of squamous-celled carcinoma of the naso-pharynx in an advanced stage has been treated by interstitial irradiation via the soft palate and posterior nares and with excellent result. This case is over one year's duration.

*Antrum.* A few cases of carcinoma of the maxillary antrum have been treated—in each case by fenestration of the antrum followed by insertion of radium, followed again by slow cavitory irradiation.

The report from the GENERAL HOSPITAL, BIRMINGHAM, contains the following conclusions arrived at as the result of treatment of cancer of the buccal cavity:

(1) Cheek and lip epitheliomata still prove to be the most amenable to radio-therapy.

During the last twelve months an attempt has been made to classify the epitheliomata into groups according to their cellular characteristics as suggested by Broder. Our experience has not borne out the suggestion that the least differentiated epitheliomata are the most radio-sensitive. The radio-sensitivity appears to vary with individual growths and not follow any cellular differentiation.

(2) Interstitial irradiation is the method of choice in the treatment of buccal cancer. Surface irradiation by dental applicators is most useful where interstitial irradiation is impossible. Many workers do not regard surface irradiation as useful, but this is quite contrary to our view.

(3) Radium necrosis and delayed radium burning have not been encountered during the last year. The use of lead protectors and increased knowledge of dosage in part accounts for this. The most important factor consists in the recognition of the optimum phase of tissue reaction to the radium. This can only be recognized by experience and in this lies the danger of the use of radium in unskilled hands. We have no doubt that an over-dose produces massive necrosis and delayed burning, while an under-dose would appear sometimes to stimulate the growth.

(4) The figures appear to show that once a clinical cure has been established over three or four years there is some hope of permanency in the result.

(5) No definite improvement in the technique for dealing with the gland fields has been evolved, and in over 65 per cent. of the fatal cases death is due to the

spread of metastases in the neck. The primary growth often remains quiescent or healed throughout.

Microscopical investigation of material removed a month after surface irradiation of the neck had been carried out showed some increased fibrosis in the glands but much active tumour material.

Table 7 gives the results of treatment of cancer of the buccal cavity over the period 1926-31 at this hospital.

TABLE 7.

<i>Group.</i>	<i>No. of cases.</i>	<i>Clinical cures.</i>	<i>Improved.</i>	<i>Not improved.</i>	<i>Dead.</i>
Tongue:					
Post. 1/3	37	11	4	4	18
Ant. 2/3	33	9	3	1	20
Floor of mouth	26	5	3	3	15
Soft palate .	6	2	1	1	2
Hard palate .	4	—	—	1	3
Check . . .	37	24	—	2	11
Lip . . . .	17	11	—	—	6
	160	62	11	12	75

The above results are expressed as percentages as follows:

Tongue:				
Post. 1/3	30%	of all cases	constitute	clinical cures.
Ant. 2/3	27	"	"	"
Floor of mouth	19	"	"	"
Check and lip growths	65	"	"	"

At the ROYAL INFIRMARY, CARDIFF, the methods of treatment of buccal cancer have been the same as those described in last year's report. Thirty-seven cases of buccal growths have been seen during the year, and 18 of these patients showed cervical glandular enlargement on their first visit to the hospital. With the exception of 1 case of carcinoma of the lip, which was excised, all the primary growths have been treated with buried radium needles. Histological examination of the growth was made in 18 instances, and when graded according to the degree of anaplasia, fall into the following groups:

<i>Disease.</i>	<i>Broder's Group.</i>			
	<i>i.</i>	<i>ii.</i>	<i>iii.</i>	<i>iv.</i>
Tongue . . .	1	5	0	2
Lip . . . .	2	1	1	0
Floor of mouth	0	1	1	0
Gum . . . .	0	1	2	1

Encouraging results have been obtained in the treatment of some of the more advanced cases of buccal cancer which had already invaded the jaw. Two cases of carcinoma of the floor of the mouth with definite malignant invasion of the mandible were treated over 12 months ago. Needles were inserted widely into the softened bone, and at present the patients are well and appear to be free from disease.

The report from DUBLIN contains the following paragraphs on the treatment of buccal carcinoma:

Total number of cases seen, 93. Treated, 71. Unsuitable, 22.

The primary growths were treated by implantation, except in a few cases (carcinoma of the gums and hard palate), in which radium-bearing plates were used. The radium or radon was screened by 0.6 mm. of platinum, and the needles have an intensity of 0.66 mg. or 1.8 mc. per cm. Birkett's technique of implantation and dosage were employed.

Surgery was preferred to radium in the treatment of four cases of lingual cancer. In all a small growth had occurred on the tongue, which was the site of severe chronic glossitis. It was excised by diathermy, because one felt that the condition of the tongue rendered irradiation inadvisable. Two of these cases are still free from disease.

All cases were asked to report 8 weeks after the primary growth had been treated. If any induration was present in the treated area, this was excised by diathermy. If mobile glands were present, they were removed by a block dissection. Inoperable glands were treated by implantation, or, if the primary growth was clinically a sensitive one, by high voltage X-rays. In some cases the latter has been of considerable palliative value, and appeared to be quite as efficient as surface radium treatment. The use of radium-bearing moulds has been discontinued. For economic reasons, it is not possible to work at a greater skin distance than 3 cm. and under these conditions a sufficiently large percentage depth dose is not obtained.

The MIDDLESEX HOSPITAL reports as follows on carcinoma of the buccal cavity:

*Epithelioma of lip.* In previous years the great majority of these cases have been treated by the insertion of radium needles beneath the ulcer and in the tissues of the chin in the line of lymphatic spread. During 1931 these cases were treated by surface application of radium on moulded applicators made of Columbia paste. The applicator is moulded to encircle the lesion and extend down on the buccal surface into the labio-alveolar sulcus and on the external surface towards the chin. The average thickness of Columbia paste used for this purpose is 7 mm.

*Epithelioma tongue, tonsil, floor of mouth.* In these cases the primary lesion has been treated as in former years by the insertion of radium or radon needles. During 1931, however, when radium needles were used, the intensity of the needles was reduced to 0.6 mg. radium element per cm. of active length, the needles being left *in situ* for from 6 to 8 days according to the case.

In cases of epithelioma of the anterior part of the floor of the mouth, adherent to the mandible, needles have been inserted around the growth on the side away from the mandible and a surface application has been made to the growth on Columbia paste applicators both from the buccal aspect and from the submental region.

In the majority of cases of epithelioma of the tongue and tonsil, when glands have been small and freely movable, or not palpable, a dissection of the glands of the neck has been carried out and, if histological examination showed that these glands were invaded by epithelioma, a surface application on a Columbia paste applicator has been applied. Where the glands have been larger and more fixed treatment has been carried out by the insertion of radium or radon needles into the deeper part of the mass from the skin surface followed by a surface application. In some cases a surface application alone has been applied to the glandular area.

The surface applicators employed are moulded for each individual patient and are built up from successive layers of Columbia paste. They are designed to irradiate the whole glandular area of the neck—i.e., about 150 sq. cm. on each side. The distance between radium and skin surface which has been employed in most cases has been 5.5 cm., it being found impossible to exceed this with the radium supplies at our disposal.

The filtration employed is equivalent to 1 mm. platinum.

The report from this hospital also contains the following histological report of epithelioma of the tongue and floor of the mouth:

Histological classification of the tumours was attempted in 26 cases, the grading being done on the lines first suggested by Broders (1920). The material was classified into three groups, the main characteristics of which may be classified as follows:

Group I. Keratinizing epithelium predominant.

„ II. Epithelial elements present roughly in the proportions found in normal skin.

„ III. Undifferentiated epithelium predominant.

It is obvious that these groups are not sharply defined but are merely an indication of the general histological appearance of the tumour.

Figures 3, 4, 5, and 6 show the type tumour in each group.

The distribution of the cases was as follows:

	Group I.	Group II.	Group III.
Tongue. Anterior 2/3	7	3	3
„ Posterior 1/3	1	1	1
Floor of mouth	4	4	2
	—	—	—
	12	8	6

Owing to the short time which has elapsed since the treatment of these cases it has been impossible to determine the relative radio-sensitivity of these groups.

At the ROYAL FREE HOSPITAL the technique described in last year's report has been continued, except that in treating glands of the neck a larger concentration of radium at a greater distance is used.

Table 8 gives the results of radium treatment of lesions of the buccal cavity and metastatic glands of neck at this hospital since 1928.

TABLE 8.

Year.	Cases treated.			Total number alive after 1 year.			Total number alive after 2 years.			Total number alive after 3 years.		
	A.	B.	Total.	A.	B.	Total.	A.	B.	Total.	A.	B.	Total.
1928	4	4	8	—	1	1	—	1	1	—	1	1
1929	11	15	26	5	6	11	2	5	7			
1930	12	13	25	6	6	12	1	—	1			
1931	7	6	13									

A — without glandular involvement when first seen.

B — with „ „ „

There has been little alteration in the technique employed at ST. BARTHOLOMEW'S HOSPITAL, the general policy being to use small doses with a filtration of 0.6 mm. platinum spread over long periods. Out of 4 cases of carcinoma of the fauces treated at this hospital, 1 is alive and well 2½ years after treatment, 2 died respectively 2 and 2½ years after treatment, and 1 is alive 4 months after treatment.

During 1931 5 cases of carcinoma of the maxilla have come under treatment or observation. Four of these cases are well respectively 9, 4½, 3, and 1 year after treatment, and the last case is untraced 6 months after treatment.

The following table gives the results of the treatment of carcinoma of the tongue in the Surgical Unit at this hospital since 1928.

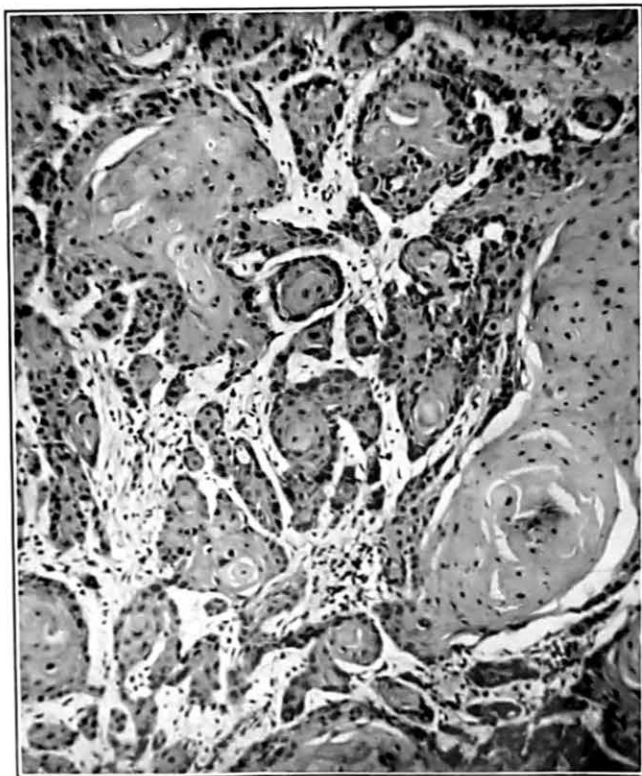


FIG. 3. Group I  $\times 100$

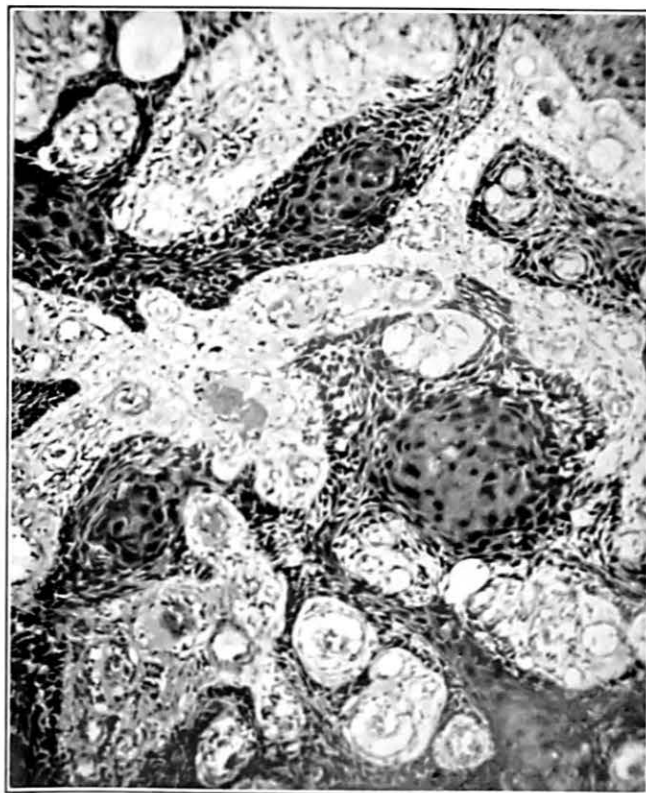


FIG. 4. Group II  $\times 100$

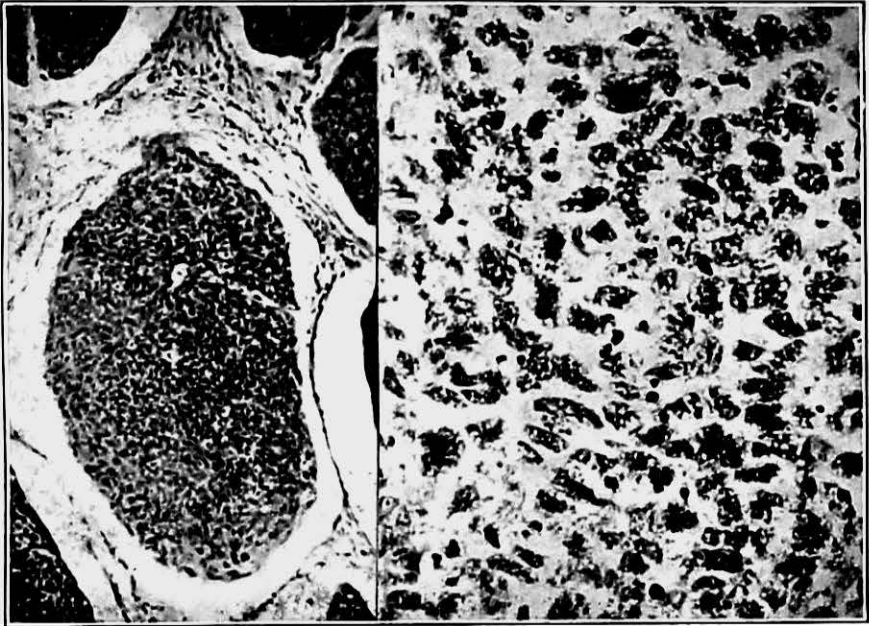


FIG. 5. Group III  $\times 100$

FIG. 6. Group III  $\times 450$



TABLE 9.

Year of treatment.	Number treated.	Number surviving at end of			
		1928.	1929.	1930.	1931.
1928	15	12	9	7	5
1929	13	—	10	7	4
1930	7	—	—	7	4
1931					

The report from UNIVERSITY COLLEGE HOSPITAL contains the following description of the treatment of carcinoma of the tongue:

(1) *Primary growth.* Interstitial irradiation with needles of low intensity is used for 7 to 10 days. In most cases the needles are introduced through the mouth, but for growths in the posterior third they may be introduced through the submental region. In the former method the needles are stitched to the mucosa of the tongue, the threads are brought out of the mouth at one angle where they are passed through a bent rubber tube, which is fixed back to the cheek by a transfixing suture. During treatment the patient is discouraged from talking and is fed with fluids given with a feeding cup having a long mouthpiece. The mouth is cleansed by frequent syringing.

(2) *Glands.* A. *Glands impalpable or palpable but operable.* Block dissection. X-rays have been used in some cases, the patients having refused operation. In some cases operation has been combined with further irradiation of the deep part of the tongue and also interstitial irradiation of the periphery of the dissected area in the neck. B. *Glands inoperable.* Interstitial irradiation and/or X-rays. Surface irradiation with radium has not been used lately as we have found that interstitial irradiation gives better results.

The results of treatment of carcinoma of the tongue at this hospital are given in Table 10.

TABLE 10.

	Year of treatment.				
	1925.	1927.	1928.	1929.	1930.
Dead . . .	1	1	6	6	11
Alive . . .	—	—	—	3	
Untraced . .					
Total . . .	1	1	6	9	11

Of the 1929 patients 1 died this year of intercurrent disease. No recurrence or metastases found at autopsy. Section of tongue shows no carcinoma. Of the 1930 patients 1 died of cerebral thrombosis following tooth extraction and was not irradiated; another had carcinoma of the oesophagus in addition to the growth in his tongue. Of the remaining cases treated in 1930, 2 only were operable.

## (2) Larynx.

KING'S COLLEGE HOSPITAL report that they have treated 3 cases of carcinoma of the larynx during the year under review. One patient had an interstitial insertion of radon seeds into the larynx followed 3 weeks later by a radium collar to secondary deposits in glands in the neck. This patient has derived some benefit from the treatment.

The other 2 cases were treated with radon, 1 by an interstitial insertion of radon seeds locally, and the other by an interstitial insertion of radon seeds into very large metastases in the glands in the neck. The latter case cannot be traced, and is presumed to be dead, while the former case is going steadily downhill.

At ST. GEORGE'S HOSPITAL 5 cases of carcinoma of the larynx have been treated in 1931. Of these 2 are clinical cures and 3 have died. The report states, 'In the radium treatment of carcinoma of the larynx the results are extremely uncertain and there is great liability to sepsis and radium necrosis, for these reasons all operable cases in future will be treated by a complete laryngectomy.'

UNIVERSITY COLLEGE HOSPITAL reports as follows on the treatment of carcinoma of the larynx:

This disease is still treated by operation in the majority of cases. In 1929, 2 cases were treated by irradiation with fenestration of the thyroid cartilage. One of these died this year without local recurrence, but with metastases in the spine, having survived two years in perfect health. The following case has been treated this year with apparent success:

M. aged 29. Extensive growth, both cords destroyed, extension down trachea. Bilateral fenestration operation for irradiation of cords. Interstitial irradiation of tracheal extension through tracheotomy. Gland dissection intended, but patient refused. Result: primary growth completely healed; glands enlarged.

### (3) Oesophagus.

The report from ABERDEEN ROYAL INFIRMARY states that at this Centre cases of cancer of the oesophagus are treated either by cavitary irradiation by means of radium or by radon insertion. In the former case a modified Symonds' tube is inserted by the aid of an oesophago-scope. In most cases a preliminary gastrostomy has been essential.

The BIRMINGHAM GENERAL HOSPITAL reports as follows on cancer of the oesophagus:

A number of new cases have been treated for cancer of the oesophagus, but we regret to say that no favourable progress has been made as yet. This is due chiefly to (1) the late date at which these cases present themselves, when it is probable that extensive peri-oesophageal infiltration and glandular metastatic deposits have already taken place; and (2) it is now quite clear that as in cancer of the rectum, cancer of the oesophagus is relatively insensitive to radium.

The usual experience is that when first treated the initial effect is good—there is retrogression of the growth and the patient and the surgeon are both pleased with the result. Subsequent treatments, however, have not maintained the progress, although swallowing has been greatly improved and often is satisfactorily retained until death.

During the year a combination of interstitial applications with radon, together with central applications of radium needles, has been tried simultaneously. In this connexion we have introduced hard rubber tubes, hexagonal in cross-section, which enable the radium needles to be kept in position and at the same time avoid any secondary radiation from a metal tube. We are now trying variations in the technique to see if we can influence the growth more favourably.

The main research problem in cancer of the oesophagus, as in cancer of the rectum, appears to be to influence the growth in this region to make it as susceptible to radium as that in the mouth and breast.

UNIVERSITY COLLEGE HOSPITAL gives a detailed report as follows of 2 cases of carcinoma of the oesophagus treated during 1931:

M., aged 49. Stricture at level of D 6 and 7. Right side thoracotomy, exposure of carcinoma 5 cm. long. Radon seeds introduced into growth, which was found to be partly necrotic. Pleura opened during operation. Good progress for one week, then developed pyrexia. Death 13 days after operation. Probably pyothorax. P.M. refused.

M., aged 65. Stricture of lower third of oesophagus. Left side thoracotomy after preliminary pneumothorax. Growth exposed without opening pleura. Found to be 5 cm. long with lower end close to diaphragm. Radon seeds introduced into growth. Patient made a good recovery from operation. A fortnight later there was slight inflammation of the wound and signs of fluid in the chest, which in a radiogram appeared to be mainly extrapleural. Six weeks after operation patient could swallow soft solids. He died suddenly a fortnight later, 2 months after operation. P.M. revealed two separate lesions in the oesophagus, (1) a punched out necrotic ulcer at the lower end, in the base of which the radon seeds were found. From this a purulent track led to a large extrapleural collection of pus. (2) Two inches higher a large carcinomatous ulcer  $3\frac{1}{2}$  in. in diameter. This was missed at operation and probably was the main growth, the lower ulcer which was irradiated being an implantation metastasis. There was no evidence of carcinoma in the lower ulcer at P.M. It is probable that an overdose of irradiation was given and that the pyothorax resulted from acute necrosis of the oesophagus. The dose was 25 mc. in 20 Muir standard seeds.

## D. CANCER OF THE RECTUM, BLADDER, PROSTATE, AND PENIS

### (1) Rectum.

KING'S COLLEGE HOSPITAL reports on 5 cases of cancer of the rectum, of which all were inoperable and 2 had previously had radium treatment in 1930. Two of the cases were treated with radon, 1 having a single insertion of radon seeds, and the other 2 insertions of radon seeds into the growth. The former case died 3 months after the treatment, while the latter case has shown some slight improvement locally, which may however only be due to a colostomy. One of the cases was treated by an interstitial insertion of radium needles, and died 3 months later. Two cases, previously treated with radium in 1930, had further interstitial insertions of radon seeds locally this year. Both cases are alive, but the growth is not definitely diminished in size in either case and the patients are slowly going downhill.

At the MARIE CURIE HOSPITAL 21 cases of cancer of the rectum—3 operable, 15 inoperable, and 3 recurrences after operation—have been treated during the last 4 years. The 3 operable cases (1 of the anus) are well from 1 to 3 years after treatment and there are no signs of recurrence. Only 4 of the 15 inoperable cases and 1 of the recurrences are living. The methods of treatment described last year have been continued.

ST. BARTHOLOMEW'S HOSPITAL reports as follows on 12 cases of cancer of the rectum treated with radium during 1931:

#### (A) *Palliative treatment of inoperable cases (7).*

Seven inoperable cases (6 primary and 1 recurrence) were treated by palliative radiation and colostomy was performed in all cases. The primary cases all

recovered, and the recurrent case, treated by intra-rectal radon only, died 2 months later from intestinal obstruction, due to adhesions resulting from the abdominal operation a year previously.

(B) *Preliminary to excision* (5).

Five operable cases were treated by trans-peritoneal irradiation with radon at the time of colostomy, as a preliminary to excision. Four of these were excised with success later and one refused excision.

Table 11 gives the results of treatment at this Centre since 1925.

TABLE 11.

<i>Date.</i>	<i>Total cases.</i>	<i>Clinical cures.</i>	<i>Improved.</i>	<i>Cures not expected.</i>	<i>Died.</i>
1925	4	—	—	—	4
1926	6	1	—	—	5
1927	7	—	—	—	7
1928	13	4	—	—	9
1929	28	2	—	3	23
1930	14	4	1	3	6
1931	12	—	10	1	1
	84	11	11	7	55

During 1931 no operable or border-line case was treated with radium with a view to radical cure. Experience based on the 84 cases under review, and nearly 50 other cases treated elsewhere, has shown that, though in many instances the growth can be destroyed by radium, recurrence too frequently follows. Difficulty of access, correct assessment of dosage, prevention of sepsis, are factors which must all be satisfied and often present great difficulties. Further, two apparently similar cases treated on similar lines may vary considerably in their response. No great assistance has been obtained from the history of the tumour, though the rapid growing anaplastic tumour has proved the most radio-sensitive.

At the present time it is considered inadvisable to use radium for the operable cases unless surgery is contra-indicated on general grounds, or radical operation is refused.

During the first few years of this research many advanced and hopeless cases were treated, and valuable experience was gained. At the present time only those inoperable cases which offer a reasonable hope of improvement are treated. It is not considered advisable to attempt treatment unless the entire growth can be attacked, after a colostomy has been performed and visceral metastasis excluded. It is essential in these cases to treat the lines of lymphatic spread either from below or above and preferably the latter at the time of colostomy.

Only a limited number of cases of epithelioma of the anus, which is a comparatively rare disease, have been treated. In most of these response has been excellent, and colostomy can often be avoided if the case is not too advanced at the time of treatment.

A few cases of perineal recurrence following excision have been dealt with. In these temporary improvement with relief of symptoms can often be secured. In one case there has been apparent freedom from growth for over two years. Apart from radium, and perhaps X-rays, nothing else can be done for these cases.

The radium problem so far as it related to adeno-carcinoma is an extremely difficult one, more so than in any other part of the body, except, perhaps, the oesophagus and respiratory tract. From experience gained in the most successful cases it seems probable that it is necessary to employ such an intensity of irradiation as will just avoid radionecrosis and damage to healthy epithelium, and that this is much higher per c.c. than squamous carcinoma. In other words, a radium burn must only just be avoided. In the case of large growths the amount of radium employed will often make the patient very ill. If the general, as well as the local, reaction is not severe when a large growth is treated a favourable result is not

very probable. Unfortunately the margin between a lethal dose and an overdose is small, and the results of an overdose are often serious.

Heavy screenage, preferably 0.8 mm. platinum and a 10-day period using radium rather than radon, are, I believe, important points in attempts at radical treatment. It seems probable that if radon is to be as efficient as radium it should be reinforced 50 per cent. after 3 days, and 50 per cent. again after 6 days, though no experience has been gained on these lines.

When reviewing results of a new treatment it is important to concentrate on successes rather than failures. It is clear from the above tables that the results obtained, so far, are depressing, and that the time has not arrived when radium can replace surgery. Nevertheless it has been shown that radium can accomplish much. Radium can destroy an early growth of the rectum and leave the patient with normal rectal function, and it can do the same with an epithelioma of the anus. Radium employed via the abdomen can destroy an inoperable growth of the pelvic portion of the rectum and leave the patient with normal rectal function. Radium can convert an inoperable fixed growth into an operable growth, and can produce an apparent cure of a very advanced large growth.

ST. MARK'S HOSPITAL reports on 89 cases of cancer of the rectum treated with radium from 1928-31. Radium needles were inserted through the vagina, perineum, or perianal skin in 12 operable cases, 2 of them being alive and well after periods of 3 years and 2 months (with colostomy) and 2 years and 10 months (without colostomy). Six cases subsequently required perineal excision and 4 of them are now alive and well. Two recent cases were treated by intrarectal radon seeds, 1 after colostomy and 1 after local excision of a small rectal cancer. Both are at present alive and well, the tumours having disappeared.

In 11 cases treated by perineal excision, radium has been employed also, the indications being a suspected extension of the growth beyond the limits of the operation. The radium needles have been inserted into the upper part of the meso-rectum, along the lateral ligaments and into the base of the prostate. There was 1 operative death on the tenth day; post-mortem examination showed a pelvic peritonitis to be present without any definite evidence of the source of the infection. Of the 10 operative survivals, 5 were classified as B cases, 5 as C cases, B cases being those which have extended into the extra-rectal tissues but have not invaded the regional lymph nodes, and C cases those in which metastases are present in the regional lymph nodes. One B case died 3 months after operation, probably from urinary failure; 3 B cases are alive and well for periods of 3 years, 3 years, and 1½ years after operation, and 1 B case was alive and well at a year after the operation, and since then he has not been traced as his work has taken him away from his home. Of the 5 C cases, 4 are dead from recurrence in less than 18 months after operation, 1 is alive 18 months after operation; his health is poor, and he is stated to have secondary malignant deposits in the iliac glands. The conclusion drawn from this is that in B cases radiation is unnecessary, and in C cases there is no evidence that the radium treatment was beneficial either in preventing recurrence or in otherwise assisting the treatment by operation.

Abdominal irradiation by radium needles or radon seeds has been

employed in 16 cases. Operative death occurred in 6 cases, and of the remaining 10 cases 7 died unrelieved at periods varying from 3 months to 18 months. The intra-abdominal method of treatment for inoperable rectal cancers is shown by this series to be attended with high operative risk, and the late results do not appear to justify the added risks when compared with the results of simple palliative colostomy.

Nine cases have been treated with radium needling by posterior barrage, in 3 cases without colostomy. In the remaining 6 colostomy had either been established prior to the radium barrage or was effected at the same time. In this series of 9 cases there are only 2 good results. The dangers of the method are evident and are indicated by the fact that 3 of the cases required hospital treatment for more than 3 months after operation, on account of severe wound sepsis.

Eighteen inoperable cases were treated by interstitial needling from the perineum, perianal circumference, or vagina. Four cases were much relieved and are now free from symptoms, 4 cases were relieved but still have symptoms, and 2 cases are recent. The remaining 8 have died. This type of radium needling evidently has a smaller operative risk than the posterior barrage operation, but even so, several of the cases passed through a long period of post-operative suppuration, with necessity for incision of peri-rectal abscesses and slow removal of sloughs. Two females developed recto-vaginal fistulae.

Of 9 cases of recurrent carcinoma 2 only show improvement.

Twelve cases of squamous carcinoma of the anus and anal canal have been treated by radium needles, with 4 good results.

The report states, 'There is no case in this series in which an inoperable rectal cancer has been rendered operable by the use of radium.'

The SCOTTISH ASSOCIATION OF THE MEDICAL WOMEN'S FEDERATION CENTRE has devised an applicator (Fig. 7) for the treatment of cancer of the rectum. The object has been to construct an applicator which can be tolerated by the patient with no more discomfort than that ordinarily caused by a loaded rectum and can be taken out and replaced at will, allowing the rectum to be washed out; and also to ensure that the radium is not able at any point to come near enough to the mucous membrane to cause necrosis, and yet to place a source of radiation in the lumen of the gut which will irradiate any length required, and may be kept in for 5 or 6 days if this is necessary for adequate dosage. It is hoped that by supplementing this irradiation with deep X-rays, a treatment will be provided similar to the combined radium and X-ray therapy which is proving so successful in the treatment of cancer of a correspondingly deep site, the cervix uteri.

The applicator consists of a cast rubber tube. The upper half, which lies inside the rectum, is  $\frac{5}{8}$  in. in diameter; the lower half, which passes through the sphincters, is  $\frac{3}{8}$  in. in diameter. The upper part contains an ebonite holder  $4\frac{1}{2}$  in. long inside which the radium may be accurately placed. It will take four tubes of 15 mm. actual length

and 3.6 mm. outside diameter. The ebonite holder consists of a spiral tube which is flexible and a domed upper end which screws into the tube.

Over the upper  $4\frac{1}{2}$  in. of the applicator where the radium is placed there is a double bulb which can be inflated with air through an inlet in the small part of the tube. A valve is fitted at the outer end of this inlet and an ordinary inflator is used to distend the bulbs when the apparatus is in position. The bulbs are so placed that the centre of the malignant stricture will lie between them, the stricture having been found beforehand and its position measured on the apparatus. This provides that the radium will be placed in the centre of the stricture, while the healthy wall of the gut above and below will be held away by the distended bulbs.

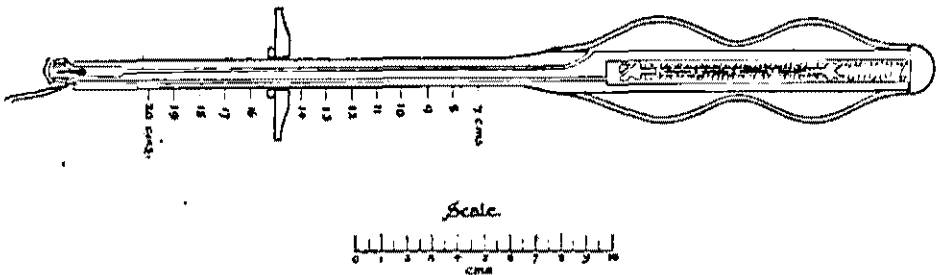


FIG. 7.

The small part of the tube below the bulbs contains besides the inlet a hole to contain a thread which fixes the ebonite radium container, and which, it is hoped, will allow the passage of gases, for which an air port is placed on the domed end. It will also carry a stilet to facilitate introduction. On the outside of this small tube is a rubber flange and socket which may be fixed in any position to act as a depth gauge.

## (2) Bladder, Prostate, and Penis.

The report from ST. PETER'S HOSPITAL states that radium has been used in the treatment of 20 cases during the year under review. In 5 of these cases, namely, penis (1 case), prostate (2 cases), and bladder (2 cases)—where suprapubic cystotomy had already been performed—needles were inserted directly into the growth. In the remaining 15 cases surgery was also used, but merely as a means of access to the growth, namely, the operation of cystotomy. In some cases of bladder-growth, open diathermy was employed prior to the implantation of needles. Doses varying from 20 to 80 mg. of radium element were used, the needles being left *in situ* for periods of 1 to 4 days.

The results of this treatment are as follows:

*Carcinoma of bladder.* Fifteen cases were treated, all inoperable. Of these 6 have since died and 2 are untraced. The remaining 7 cases are reported to have improved as a result of irradiation. In most of these the growth has entirely disappeared and in all cases bleeding

has ceased. One case recurred and was successfully treated by partial cystectomy subsequently. In nearly all cases post-operative pain was protracted and severe, infection troublesome, and convalescence prolonged and complicated. Healing of the bladder-wound was so slow that most cases were discharged from hospital with a permanent cystotomy. Radium ulcers occurred in 2 of the cases and secondary stone formation in 1.

*Carcinoma of prostate.* Four cases were treated with radium. One case has since died from metastases and 1 remains untraced. Two cases are reported to be relieved; in each case a permanent cystotomy was necessary owing to intense fibrosis around the posterior urethra.

At UNIVERSITY COLLEGE HOSPITAL 3 cases of carcinoma of the prostate have been treated this year by interstitial irradiation after exposure by suprapubic cystotomy. In 1 case treatment was followed by the rapid development of skeletal metastases, in the other 2 the result has been satisfactory, and in 1 of them the cystotomy has been closed and normal micturition re-established.

### E. CANCER OF THE EYE

The report from ST. BARTHOLOMEW'S HOSPITAL contains a detailed account of the treatment by radon seeds of 5 cases of retinal gliomata since October 1929. Although the number of cases treated so far has been small, sufficient has been done to justify further treatment along these lines, especially in bilateral growths. Platinum radon seeds with a filtration of 0.5 mm. and varying in strength from 1 to 5.3 mc. have been used. They have as far as possible been completely buried in the growth, so that no seed is seen on ophthalmoscopic examination afterwards. The following account is given of the technique of insertion of the seed:

*Exposure of the sclera.* There are several ways of reflecting the conjunctiva and Tenon's capsule for the exposure of the sclerotic, and there are two chief desiderata: first to give easy access, and secondly, we believe it is important that the reflection is so planned that the hole in the sclerotic is well distant from the incisions through the conjunctiva, so as to make the spread of infection into the globe along the track of the silk as unlikely as possible.

*The incision.* The incision through the sclera is made with a broad cutting needle; and sometimes one can get an indication as to the best direction for the track, for clearly, in the case of a sarcoma at any rate, the ideal track will be a perpendicular directed inwards from the centre of the base of the growth, and so an endeavour is made to insert the cutting needle in this direction and, with this in view, we have had needles made bent at right angles and at an obtuse angle. It seemed advisable that a track should be deliberately cut in the substance of the growth, into which the seed is to be introduced, otherwise on inserting the blunt pointed seed the growth may be pushed in front of it instead of being transfixed by it; this has happened in one case at least, and we believe that the end is best attained by inserting the needle well into the growth, thereby cutting a track in it into which the seed is introduced.

The seed is now taken in the introducing forceps and inserted, with a slight wriggling motion, through the hole in the sclerotic. This forceps is made with blades at any angle corresponding with the angle of the needle which has been used, so that the seed is inserted in the line of the track made by the needle. If the growth is of considerable size the seed is pushed right home by means of the



dimple made for the purpose on the side of the heel of the forceps, and the silk attached to the end of it is now cut short leaving a length of about  $1\frac{1}{4}$  inches, by means of which the seed is removed later. The silk should be black in colour so as to facilitate the finding of it when the seed is removed. The conjunctival flap is now replaced and sewn in position, the short piece of black silk being completely buried under it.

The seed has generally been left in for 10 days, and in order to remove it the original conjunctival incision has been opened up, the conjunctival flap turned back again, the black silk found, the hole exposed, and the seed extracted by pulling on the thread.

In the treatment of these 5 cases it has been shown that a seed of at least 5.8 mc. may be inserted into the eye, and that at least five seeds, each of a strength of 3.5 mc., may be applied to the outside of the sclera without causing sloughing of any of the tissues. It has been found that a retinal glioma will disappear under the influence of radon seeds, and that in a concrete case a glioma of moderate size not only was not increased in size 22 months after the commencement of treatment, but was shrunken and seemed to be completely scarred; it is, however, premature to say that it is cured. Opacities of a special type in the lens have been observed to develop and afterwards to disappear completely. A study of the histological changes in the glioma cells has been made.

## F. SARCOMA AND LYMPHOSARCOMA


As in previous years the attempt has been continued to correlate the clinical results of radium therapy in sarcomata with the histological types. Twenty cases have been reported on with a histological diagnosis in this year's reports and these have been added to the previous figures, bringing the total to 130. The information on these 20 cases has been contributed by the following hospitals: Birmingham (1), Cardiff (5), Dublin (3), King's College Hospital (2), Middlesex (7), St. Mark's (1), University College Hospital (2). The percentage of 'good results', meaning that the growth has disappeared and has not recurred locally, is given for those groups in which the numbers are large enough to be of value.

Spindle cell sarcoma	gave 52.0% of good results out of 25 cases.			
Round cell	"	"	41.5	"
Lymphosarcoma	"	"	25.5	"

## G. EXPERIMENTAL SECTION

The studies in this section have been carried out in different laboratories and the actual investigations extend over a rather wide field of interest, ranging as they do from elaborate studies on the behaviour of cells in what are known as tissue cultures to the response of the organism as a whole to various doses of radiation.

Beginning with some cellular studies the report from the Strange-ways Laboratory, Cambridge, gives a summary of work which has been done on the effect of gamma rays on mitosis *in vitro*. The

minimum dose of gamma radiation to produce any effect at all on mitosis is being determined over a wide range of intensities. There seems to be a characteristic curve  under these conditions, a diminution in mitosis being followed by a compensatory increase, provided the degree of damage is not too advanced. These studies give point to the importance which is, with some warrant, being attached to the special re-activity of cells in this particular phase. Previous studies have shown that if the degree of damage of the cell is great enough then there is no compensatory increase, in other words, the cells never again function properly however long an interval may be allowed for their recovery.

Dr. Muriel Robertson, working at the Lister Institute, reports upon an investigation into the effects of gamma rays upon the growth of the protozoon, *Bodo caudatus*, and secondly, into certain serum reactions which have been carried out in connexion with the radiation effects. The antiserum produced by the injection of living or formalized bodos into the blood-stream of rabbits proved to be active and could be used without the addition of complement. The serum method when applied to lysin tests of this kind always required some means of obtaining the death point of the titration series. Mere inspection is unsatisfactory and unreliable. Samples from the whole series of titration tubes were therefore placed to grow in culture plates in such a way that 1 c.c. from the tube was placed in 10 c.c. of fresh medium. The surviving bodos were therefore put to grow in a further dilution of 1 in 10 of the serum content of the tube. It is the behaviour of the flagellates developing upon these serum survival plates which reveals a change in the cells which have been exposed for a sufficient time to gamma radiation as distinguished from those which have never been exposed. The change in behaviour consists in the bodos from the irradiated strain which multiply from the small number placed upon the plates (from the titration tubes) running together to form large tightly stuck masses and clumps, while the normal bodos, with or without a brief period during which they may be slightly sticky, grow out in the usual free way.

*Bodo caudatus* cultures show a diminution in growth when grown in the presence of radium. There is a subsequent difference from the normal in the appearance of the survivors of the irradiated strain; this change persists after the removal of the radium for a number of generations, but the effect ultimately disappears.

This investigation is being continued.

Dr. Mottram, of the Radium Institute and Mount Vernon Hospital, gives the results of certain investigations upon the disappearance of lymphocytes in the blood-stream of the rat after exposure to X-rays and gamma rays. He concludes that the disappearance is due to the accumulation of these cells in the irradiated capillaries. He further mentions that macrophages lose their power of taking up trypan-blue intra-vitam after irradiation.

Dr. Mottram, together with Dr. Eidenow, also reports upon a series of experiments designed to show how tumours and the normal

skin of the rat react to single and divided doses of gamma rays. With splitting the dose they found in the case of the skin a reduction in the effect of the radiation, whereas in the case of the tumour no reduction was observed.

Professor E. Sharpey Schafer, of the Department of Physiology of the University of Edinburgh, sends an interim report upon experiments designed to show the effects of radium exposures on the calcium and inorganic phosphorus concentrations of the blood. These have been carried out by means of applications of radium over the thyroid area of dogs, cats, and rabbits, using toxic and therapeutic doses. This investigation is being carried out by Dr. Dupré.

A certain amount of work is reported upon the effects of gamma rays and X-rays on tissue metabolism and kindred processes. The Strangeways Research Laboratory reports that an investigation has been made upon the galactose breakdown of rat kidney tissue in flask cultures after exposure to gamma rays.

Experiments have been carried out by Miss Goulston to examine the effects of radiation upon the allantoic membrane of the chick embryo, more especially of radiation of various wave-lengths, in order to investigate the claims of Moppett that marked differential action of X-rays occurs with this particular structure. As a preliminary the technique of exposing the allantoic membrane was inquired into. It was found necessary to take aseptic and other precautions in order to avoid abnormal reactions and histological changes in the membrane. This preliminary work is described in the *British Journal of Experimental Pathology*, 1932, vol. xiii, p. 175.

Two communications may be referred to on the question of dosage in radio-therapy. One from Dr. Mottram showed that degeneration of the muscle of the rat occurred in the immediate proximity of bone which was situated in an irradiated region. This degeneration was considered to be due to secondary radiation emitted from the bone, other tissues nearer the radium being unaffected.

The report from the Royal Free Hospital contains an account of the effect of prolonged gamma radiation upon the heart-muscle and the liver. These observations were actually made upon the human subject in whom a radium tube was accidentally displaced after treatment for cancer of the breast. In consequence a needle containing 2 mg. Ra. El. with 0.5 mm. platinum filtration actually found its way into the right ventricle of the heart, and remained there for about 3 years; as a result the patient died of endocarditis. The following post-mortem account is given by the Pathological Department of the Royal Free Hospital.

The pericardial cavity was almost entirely obliterated by firm adhesions, similar adhesions present between the sternum, lungs, and pleura on the left. The radium needle was found in the heart. The trocar point and a third of the length of the needle was projecting into the cavity of the right ventricle, the remainder was embedded in the lower third and posterior part of the interventricular septum. A pale gelatinous zone of necrotic heart-muscle extended around the needle for a radius of about one and a half inches. Microscopically the changes in the heart-muscle were found to be due to alterations in the blood-vessels.

There was much blood-stained fluid in the peritoneal cavity. The liver was enlarged and very deformed. A large haemorrhagic tumour was present in that part of the organ immediately subjacent to the needle. Growth was present throughout the liver within a radius of about 8 in. from the needle. The growth is a malignant haemangio-endothelioma arising in the walls of the portal vein and its branches. The distribution indicates that the radium, directly or indirectly, gave rise to it. Metastatic growth was present in the lungs and bone marrow. The spleen was small and fibrous, the lymph glands slightly enlarged and reddish. The bone marrow of the shaft of the femur showed general hyperplasia. There was cortical atrophy of the suprarenals. The uterus and ovaries were atrophic. There were no other naked eye changes, but microscopy showed generalized atrophy of lymphoid tissue and widespread replacement of lymphocytes by plasma cells. Nothing but dense scar was found at the site of the original mammary cancer and there was no evidence of mammary cancer elsewhere (Figs. 8 and 9).

The MIDDLESEX HOSPITAL reports upon an attempt to express dosage in radium therapy on a comparative basis. 'An attempt has been made to use models combined with photographic records of the radiation intensity in those cases where radium is applied interstitially or externally to the head and neck. Malignant growths arising in the tongue or buccal cavity, larynx, pharynx, brain, &c., are treated either by interstitial radiation or by applying radium externally at distances ranging from 1 to 6 cm. according to the quantity of radium available. Perhaps the outstanding problem in dosage among this group of cases arises where the primary lesion of the tongue has been treated by interstitial radiation, which is then followed by a superficial application of radium for treating the glands in the neck. In the course of the latter treatment the primary lesion must of necessity receive supplementary radiation, and the attempt to make some quantitative estimate of this will be described in what follows, as a typical example of the way in which it is proposed to treat this kind of problem.

No attempt is made to express the dosage from point to point as so much energy liberated, but rather to express comparatively the way in which the dosage changes from region to region. In the first instance a life-sized model was made of a normal head. A median section through such a model allows photographic plates to be laid flush with the surface, so that it is possible, through the median line of the tongue and nasal organs, to get photographic impressions of the radiation due to an externally applied applicator. In actual therapy these surface applicators are often moulded to the part, taking up the convexity and concavity as the case may be. For this reason use has been made of three types of surface applicator, plane, convex, and concave, and a series of measurements has been carried out with each in order to show the distribution of intensity along the central axis of the applicator and over planes at right angles to this axis. If the applicators are held at different distances from the surface of the skin the problem amounts to finding out how the intensity at any depth compares with some selected region of the skin; the gamma ray absorption data are available for this purpose. With models of this kind it is possible to get comparative data, which, however, are not yet very accurate. The model itself is made of plaster of Paris;

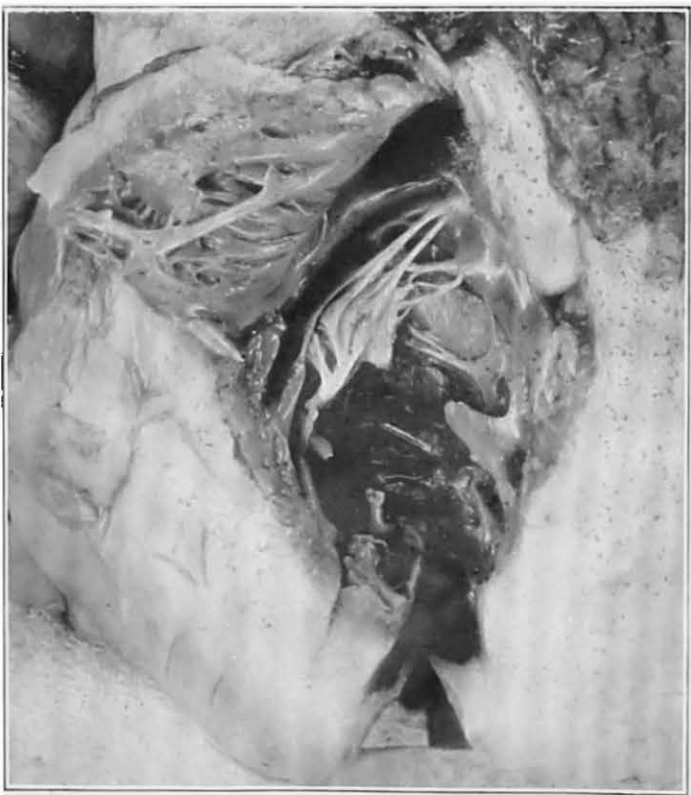


FIG. 8. The figure shows the right ventricle laid open. The needle is seen with its trocar point in the cavity and the bodkin end embedded in the interventricular septum



FIG. 9. A slice of the liver, about 2 ins. below the radium needle



FIG. 10

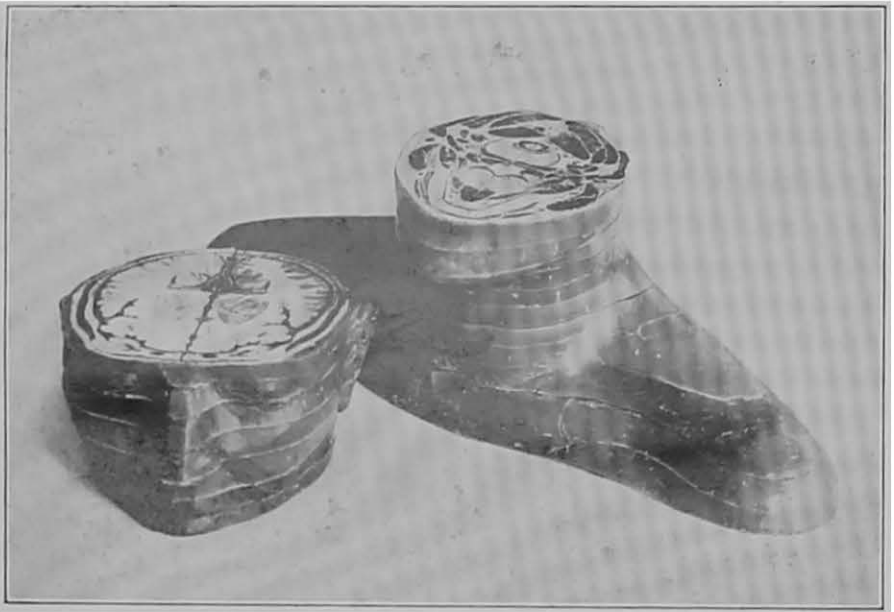


FIG. 11

the inside is filled with plasticene, the density of the whole not differing very much from that of the normal tissues.

Development of this method has been to build up a model head in a series of sections about 1 cm. thick. These are cast in wax, and superimposed upon the top and bottom surface of each section is a photograph of the structures seen in a cross-section on that plane. Fig. 10 shows the head in profile and Fig. 11 one of the cross-sections from above. The wax used is very nearly the density of the soft tissues, and for the purposes of comparative dosage the actual applicator used clinically is applied to the model and a photographic film inserted at any particular level where the dosage is in question. After a suitable exposure the film is developed under standard conditions and the relative intensity of the film measured from point to point. In order to minimize the labour involved in so many photometric determinations the relative opacity of the film from point to point is determined by a method based upon its absorption of white light, a galvanometer and selenium cell serving to register these variations.

## APPENDIX I

### *Statistical Report from the Middlesex Hospital on cases treated with radium since 1925.*

In the accompanying tables the following has been the basis for classification into stages:

*Epithelioma of the Cervix Uteri.* The method of classifying cases according to vaginal, parametrial, vesical, and rectal involvement is the same as that followed by the Radiological Sub-Commission to the League of Nations and published in the report issued in June 1929.<sup>1</sup>

The standards of classification are as follows:

#### STAGE 1.

The growth is strictly limited to the cervix uteri. Uterus mobile.

#### STAGE 2.

Lesion spreading into one or more fornices with or without infiltration of the parametrium adjacent to the uterus, the uterus retaining some degree of mobility.

#### STAGE 3.

(a) Nodular infiltration of the parametria on one or both sides extending to the wall of the pelvis, with limited mobility of the uterus or massive infiltration of one parametrium with fixation of the uterus.

(b) More or less superficial infiltration of a larger part of the vagina, with a mobile uterus.

(c) Isolated metastases in the pelvic glands with a relatively small primary growth.

(d) Isolated metastases in the lower part of the vagina.

Generally speaking, all cases not falling into Stages 2 or 4 will be placed under Stage 3.

#### STAGE 4.

(a) Cases with massive infiltration of both parametria extending to the walls of the pelvis.

(b) Carcinoma involving the bladder or rectum.

(c) The whole vagina infiltrated (rigid vaginal passage) or one vaginal wall infiltrated along its whole length with fixation of the primary growth.

(d) Remote metastases.

*Epithelioma of the Skin* has been divided into two stages:

(I) Lesions involving skin only.

(II) " " deeper structures.

*Epitheliomata of the Tongue, Lip, Floor of Mouth, Buccal Surface of*

<sup>1</sup> League of Nations Radiological Sub-Commission Reports, June 1929. Series of League of Nations publication III, Health, 1929. III. 5. Official No. C.H. 788.



Cheek, Tonsil, Palate and Fauces, and Carcinoma of Breast have been divided into three stages:

- (I) No glands palpable.
- (II) Glands palpable but freely movable.
- (III) Inoperable.

Disease. EPITHELIOMA OF THE CERVIX UTERI.  
Stages I, II, III, and IV.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untreated at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alice 1932.	Died after 5 years.		
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.	
1925		9	7	3	3	2	1		2			2	4		1	1	8	1		
1926		8	6	4	3	1	1					2	2	1	2		7		1	
1927		19	17	11	8	7	5					2	6	3	1	2	14	5		
1928		43	38	12	7	5		1				5	26	5	1		37	5		
1929		38	27	14	9			1				10	13	5			28	9		
1930		20	13	6				2				7	5				12	6		
1931		23	14									9					9	14		

Stage I.

Year.	Total Treated.	Alive years after treatment.					Untreated at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alice 1932.	Died after 5 years.			
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.		
1925	1	1	1	1										1		1				
1926																				
1927	3	3	2	2	2	2						1				1	2			
1928	3	3	2	2	1							1		1		2	1			
1929	5	4	2	1								1	2	1		4	1			
1930	2	2	2														2			
1931	3	2										1				1	2			

Stage II.

1925	1	1										1				1				
1926	1	1	1	1										1		1				
1927	3	3	1	1	1	1						2				2	1			
1928	8	8	2	1	1							6	1			7	1			
1929	8	6	4	3								2	2	1		5	3			
1930	3	2										1	2			3				
1931	1	1															1			

EPITHELIOMA OF THE CERVIX UTERI (continued)

Stage III.

Year.	Total Treated.	Alice years after treatment.					I intraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alice 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925	6	5	2	2	2	1		1		1	3			1	5	1		
1926	4	2	1	1	1	1				2	1				3		1	
1927	11	9	6	4	3	2				2	3	2	1	1	9	2		
1928	25	22	7	4	3		1			3	15	3			21	3		
1929	21	16	8	5			1			4	8	3			15	5		
1930	7	4	2				2			3					3	2		
1931	13	8						1		5					5	8		

Stage IV.

1925	1							1		1					1			
1926	3	3	2	1							1	1	1		3			
1927	2	2	2	1	1							1		1	2			
1928	7	5	1							2	4	1			7			
1929	4	1								3	1				4			
1930	8	5	2							3	3				6	2		
1931	6	3						1		3					3	3		

In addition to the patients shown in the tables of carcinoma of the cervix.

1925. 1 case of carcinoma of the body of the uterus was treated. This patient died in 1927, i.e. the third year after treatment.

1 patient with epithelioma of the cervix received one treatment by radium and was then treated by radical operation. This patient died in 1927, i.e. the third year after treatment.

1926. 3 cases with recurrent carcinoma of the cervix were treated. Of these: 1 patient remains alive at the beginning of 1932, i.e. 6 years after treatment; 1 patient remained alive until 1931, i.e. 5 years after treatment, when she developed a carcinoma of the breast for which she received treatment by radium but died in 1931; 1 patient died in 1926.

1 patient with epithelioma of the vulva was treated. This patient remained alive at the beginning of 1932.

1 patient with recurrent epithelioma of the vulva after operation was treated. This patient died in 1928, i.e. in the third year after treatment.

1927. 3 patients with recurrent epithelioma of the cervix were treated. Of these: 1 remains alive at the beginning of 1932, i.e. 5 years after treatment; 1 patient died in 1929, i.e. in the third year after treatment; 1 patient died in 1928, i.e. in the second year after treatment.

1928. 2 patients with carcinoma of the body of the uterus were treated and both were alive at the beginning of 1932, i.e. 4 years after treatment.

- 2 patients with *recurrent epithelioma of the cervix* were treated; both these patients died in 1929, i.e. the second year after treatment.  
 1 patient with *epithelioma of the vaginal wall* was treated. This patient died in 1931, i.e. the fourth year after treatment.
1929. 3 patients with *carcinoma of the body of the uterus* were treated. Of these: 2 died in 1930 and 1 died in 1929.  
 4 patients with *recurrent epithelioma of the cervix* were treated. Of these: 2 patients were alive at the beginning of 1932, i.e. 3 years after treatment; 2 patients died in 1930, i.e. in the second year after treatment.  
 2 patients with *epithelioma of the vagina* were treated. Of these: 1 died in 1929 and 1 died in 1930.  
 1 patient with *epithelioma of the vulva* was treated and died in 1931.  
 1 patient with *recurrent epithelioma of the vulva* was treated and has not been traced since.
1930. 1 patient with *sarcoma of the uterus* was treated and died in 1930.  
 2 patients with *recurrent epithelioma of the cervix* were treated. 1 died in 1930 and 1 died in 1931.  
 1 patient with *epithelioma of the vagina* was treated and died in 1931.  
 2 patients with *epithelioma of the vulva* died in 1930. Of these, 1 patient also received X-ray treatment.  
 1 patient with *recurrent epithelioma of the vulva* died in 1930.
1931. 4 patients with *carcinoma of the body of the uterus* were treated. Of these: 1 died in 1931.  
 4 patients with *recurrent epithelioma of the cervix* were treated. 3 died in 1931.  
 1 patient with *epithelioma of the vagina* was alive at the beginning of 1932.  
 2 patients with *epithelioma of the vulva* were treated. Both these patients were alive at the beginning of 1932.  
 1 patient with *sarcoma of the uterus* and 1 patient with *adeno-carcinoma of the cervix and malignant ovarian cyst* had sub-total hysterectomy followed by radium application to vagina. They both remained alive at the beginning of 1932.  
 1 patient with *carcinoma of Bartholin's gland* was alive at the beginning of 1932.

## Disease. EPITHELIOMA OF THE SKIN.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		2	1	1	1	1	1									1			
1926		6	5	2	1	1	1			1	3	1			5	1			
1927		4	3	2	1	1	1				1	1			2	1			
1928		2	2	1	1	1					1				1	1			
1929		5	3					1	1	2	2				4				
1930		13	12	9			1			1	2				3	9			
1931		6	5							1					1	5			

EPITHELIOMA OF THE SKIN (*continued*)

## Stage I.

Year.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925	1	1	1	1	1	1									1			
1926																		
1927	1	1	1	1	1	1									1			
1928																		
1929	1	1							1									
1930	5	5	5												5			
1931	3	3													3			

## Stage II.

1925	1						1										
1926	5	4	1						1	3	1			5			
1927	1	1	1								1			1			
1928	1	1	1	1	1										1		
1929	4	2						1	2	2				4			
1930	8	7	4				1		1	2				3	4		
1931	3	2							1					1	2		

## SKIN

In the first table all patients in whom radium was used in treatment have been included.

1926. 1 patient who remained well in the beginning of 1932 was treated by operation and insertion of radium.

1927. 2 patients of whom 1 is untraced and 1 died in the second year were treated by excision and insertion of radium.

1928. 1 patient who died in the second year was treated by excision and insertion of radium.

1931. 1 patient who remains alive at the beginning of 1932 was treated by excision and insertion of radium.

These 5 patients have been omitted from the tables showing patients treated by radium divided into stages according to extent of the disease.

1926. 1 patient in Stage II who died in the third year was treated by radium for post-operative recurrence.

1929. 1 patient in Stage II who died in the same year was treated by radium for post-operative recurrence.

1930. 1 patient in Stage II of this year was treated by radium and operation and remained alive at the beginning of 1932.

Disease. EPITHELIOMA OF THE TONGUE.

Stage. All cases in which radium was used for treatment.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untreated at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		7	3	3	2	2	2	3			1		1			2	1	1	
1926		6	2					2			2	2				4			
1927		17	11	7	5	3	3				6	4	2	2		14	3		
1928		30	21	9	2	1				1	8	12	7	1		28	1		
1929		27	18	7	4			2			9	11	3			23	4		
1930		26	13	8				1	1		13	4				17	8		
1931		20	16								4					4	16		

Stage I.

Year.	Total Treated.	Alive years after treatment.					Untreated at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925	1	1	1	1	1	1									1			
1926																		
1927																		
1928	6	5	2	1	1					1	3	1			5	1		
1929	10	9	5	4						1	4	1			6	4		
1930	9	6	3							3	3				6	3		
1931	8	7								1					1	7		

Stage II.

1925																	
1926	1									1					1		
1927	4	4	3	3	3	3					1				1	3	
1928	9	8	4	1					1		4	3	1		8		
1929	3	2								1	2				3		
1930	8	5	4					1	1	3					3	4	
1931	5	4								1					1	4	

EPITHELIOMA OF THE TONGUE (*continued*)

## Stage III.

Year.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925	4						3			1					1			
1926	4	1					3			1	1				2			
1927	9	4	3	1						5	1	2	1		9			
1928	15	8	3							7	5	3			15			
1929	14	7	2				2			7	5	2			14			
1930	9	2	1							7	1				8	1		
1931	6	4								2					2	4		

## TONGUE

In the first table all patients in whom radium was used in treatment have been included.

Of these:

1925. 2 patients were treated by excision and insertion of radium.

1926. 1 patient was treated by excision and insertion of radium.

1927. 4 patients were treated by excision and insertion of radium.

These 7 patients have been omitted from the tables showing patients treated by radium divided into stages according to the extent of the disease.

1925. The patient marked Stage I was treated in 1925 by hemiglossectomy but had a large recurrence in 3 months and was then treated by radium. The patient in Stage III who died in the first year was treated by radium for a recurrence following operation.

1926. 1 patient in Stage III who is untraced was treated by radium for post-operative recurrence.

1927. 1 patient in Stage II who was alive at the beginning of 1932 was treated by radium for post-operative recurrence. 4 patients in Stage III were treated by radium for post-operative recurrences.

1928. 3 patients in Stage III were treated by radium for post-operative recurrences.

1929. 1 patient in Stage II who died in the second year was treated by radium for post-operative recurrence. 1 patient in Stage III who died in the third year was treated by radium for post-operative recurrence.

1930. 1 patient in Stage II who remained alive at the beginning of 1932 was treated by radium for post-operative recurrence. 1 patient in Stage III who remained alive at the beginning of 1932 was treated by radium for post-operative recurrence.

1931. 1 patient who remained alive at the beginning of 1932 developed a carcinoma of right side of glands of neck in 1931. He received treatment by surface application of radium for this. 3 months later he developed a large epithelioma of left side of tongue for which he also received radium treatment.

Disease. EPITHELIOMA OF THE LIP.

Stage. All cases in which radium was used for treatment.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Unrecol at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		3	3	2	2	1	1					1	1		2	1			
1926		3	1	1	1	1	1				2				2	1			
1927		5	3	2	2	2	2				2	1			3	2			
1928		7	7	6	6	6					1				1	6			
1929		16	15	11	9						1	4	2		7	9			
1930		14	13	9			1	1		1	3				4	9			
1931		11	9				1		1							9			

Stage I.

Year.	Total Treated.	Alive years after treatment.					Unrecol at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925	1	1	1	1	1	1									1			
1926	1	1	1	1	1	1									1			
1927	1	1	1	1	1	1									1			
1928	5	5	5	5	5										5			
1929	7	7	6	4						1	2			3	4			
1930	7	7	6							1				1	6			
1931	9	7				1		1							7			

Stage II.

1925																	
1926																	
1927																	
1928	1	1	1	1	1										1		
1929	4	4	4	4											4		
1930	3	3	3												3		
1931	2	2													2		

EPITHELIOMA OF THE LIP (*continued*)

## Stage III.

Year.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925	2	2	1	1							1		1		2			
1926	1									1					1			
1927	2	1								1	1				2			
1928	1	1									1				1			
1929	3	2								1	2				3			
1930	4	3					1	1		1	2				3			
1931																		

## EPITHELIOMA OF THE LIP

In the first table all patients in whom radium was used in treatment have been included.

Of these:

In 1926 1 patient with fixed glands was treated by excision of the primary lesion and insertion of radium into the glands.

In 1927 2 patients were treated by excision and insertion of radium.

In 1929 1 patient was treated by excision and insertion of radium; 1 patient was treated by excision followed by prophylactic surface radiation.

These 5 patients have been omitted from the tables showing patients, treated by radium, divided into stages according to extent of the disease.

The 3 patients treated in 1925 all had recurrences after operation. The patient in Stage III, 1926, had a recurrence after operation. Both patients in Stage III, 1927, had recurrences after operation. The patient in Stage III, 1928, had a recurrence after operation. 1 patient in Stage I and 1 patient in Stage III, 1929, had recurrences after operation.

## Disease. CARCINOMA OF THE FLOOR OF THE MOUTH.

Stage. All cases in which radium was used for treatment.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		1						1											
1926		3	1						1		2	1			3				
1927		4	2	2	2	2	2				2				2	2			
1928		5	4	2	2	2					1	2			3	2			
1929		16	11	7	5			1			5	4	2		11	5			
1930		17	13	8							4	5			9	8			
1931		11	7						2		4				4	7			



Stage I.

Year.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Cause 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925																		
1926																		
1927																		
1928																		
1929	4	4	3	3						1				1	3			
1930	5	5	4							1				1	4			
1931	2	2													2			

Stage II.

1925																	
1926	1	1								1			1				
1927	1	1	1	1	1	1								1			
1928	2	2	1	1	1					1			1	1			
1929	4	3	2	2			1		1	1			2	2			
1930	5	4	3						1	1			2	3			
1931	3	3												3			

Stage III.

1925	1					1											
1926	2						1		1				1				
1927	2								2				2				
1928																	
1929	8	4	2						4	2	2		8				
1930	7	4	1						3	3			6	1			
1931	6	2					2		4				4	2			

FLOOR OF MOUTH

In the first table all patients in whom radium was used in treatment have been included.

Of these:

1926. 1 patient in Stage III was treated by diathermy and radium.

1927. 1 patient in Stage I was treated by diathermy and radium.

1928. 3 patients, 1 in Stage I and 2 in Stage III, were treated by diathermy and radium.

These 5 patients have been omitted from the tables showing patients treated by radium divided into stages according to the extent of the disease.

1927. The patient grouped Stage II was suffering from a recurrence after excision of what was diagnosed as a carcinoma of the sublingual gland.



Stage III. Treated solely by radium.

Year.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alice 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925	3	2					1				2				2			
1926	2	1							1	1					2			
1927	1	1								1					1			
1928	3	2	1						1	1	1				3			
1929																		
1930	1								1						1			
1931	2	1							1						1	1		

CHEEK (BUCCAL SURFACE)

In the first table all patients in whom radium was used in treatment have been included.

Of these:

1925. 1 patient was treated by diathermy excision of the growth and radium tubes were then inserted.

1927. 1 patient had excision of the lesion by diathermy and then insertion of radium. In 1 case radium was inserted as a prophylactic after operation.

1928. 1 patient had excision of the lesion by diathermy and then insertion of radium.

These 4 patients have been omitted from the tables showing patients treated by radium divided into stages according to extent of the disease.

The patient of Stage I treated in 1929 developed, in 1930, a recurrence which was removed by operation.

Disease. CARCINOMA OF THE TONSIL, PALATE, AND FAUCES.

Stage. All cases in whom radium was used for treatment.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alice 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		6	4	3				2				1	3			4			
1926		3	1					2			1					1			
1927		6	5	1	1	1		1			4				1	5			
1928		12	5	3	3	3		1			6	2				8	3		
1929		5	4	3	2						1	1	1			3	2		
1930		7	5	2							2	3				5	2		
1931		12	8								4					4	8		

CARCINOMA OF THE TONSIL, PALATE, AND FAUCES (*continued*)

## Stage I.

Year.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925																		
1926																		
1927	1	1	1	1	1								1	1				
1928	5	4	3	3	3	1				1				1	3			
1929	2	1	1	1					1					1	1			
1930																		
1931																		

## Stage II.

1925																		
1926																		
1927																		
1928	2	1							1	1				2				
1929	1	1	1							1				1				
1930	1	1								1				1				
1931	6	4						2	2					2	4			

## Stage III.

1925	5	4	3			1			1	3				4				
1926	3	1				2			1					1				
1927	3	2				1			2					2				
1928	3								3					3				
1929	2	2	1	1					1					1	1			
1930	5	4	2						1	2				3	2			
1931	6	4						1	2					2	4			

## TONSIL, PALATE, AND FAUCES

In the first table all patients in whom radium was used in treatment have been included.

Of these:

1925. 1 patient who is untraced was treated by excision and insertion of radium.  
1927. 2 patients both of whom died in the second year were treated by excision and insertion of radium.

1928. 2 patients both of whom died in the first year were treated by excision and insertion of radium.

1930. 1 patient who died in 1930 was treated by excision and insertion of radium.

These 6 patients have been omitted from the tables showing patients treated by radium divided into stages according to the extent of the disease.

1928. Of the 3 patients in Stage III 2 were treated by radium for post-operative recurrence.
1929. The patient in Stage III who remained alive at the beginning of 1932 was treated by radium for a recurrence following radium treatment elsewhere.
1930. Of the patients in Stage III, 1 who died in the second year was treated by radium for post-operative recurrence.
1931. Of the 2 patients in Stage II who died as the result of their treatment, 1 died following an anaesthetic for the insertion of radium; the other patient had an extensive primary carcinoma of the stomach.

The patient in Stage III who died as the result of treatment died under anaesthetic at the conclusion of an operation for the insertion of radium. The other patient in Stage III who is dead, died following complete dental extraction 6 weeks after the completion of radium treatment.

*Disease. CARCINOMA OF MAXILLA.*

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Withdrawn at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		4	3	2	1	1	1					1	1			2	1		
1926		2	2	2	1	1	1						1			1	1		
1927		6	2	2	1	1	1				3		1			4	1		
1928		4	1	1	1	1		1			2					2	1		
1929		2	2	2	2												2		
1930		2	2									2				2			
1931		4	3								1					1	3		

*Disease. CARCINOMA OF ALVEOLAR MARGIN.*

1925																			
1926		3	3	1								2	1			3			
1927		2					1				1					1			
1928		1	1	1	1								1			1			
1929		1	1									1				1			
1930		1									1					1			
1931																			

*Disease. CARCINOMA OF GLANDS OF NECK. No primary lesion discovered.*

1925		7	4	3				2			1	1	3			5			
1926		3	1					1			1	1				2			
1927		1	1									1				1			
1928		1									1					1			
1929		9	8	5	4						1	3	1			5	4		
1930		9	7	4				1			2	2				4	4		
1931		6	5						1		1					1	5		

MEDICAL USES OF RADIUM

MAXILLA AND MANDIBLE

- 1925. In the case of the patient who remains well in 1932 the diagnosis is uncertain . The material examined histologically was suggestive of an odontome.
- 1927. Of the patients treated in this year, 1 who died in the first year and 1 who died in the third year were treated by a combination of excision and radium.
- 1928. All 4 patients treated in this year were treated by a combination of excision and radium.
- 1929. 1 of the patients treated in this year was treated by a combination of excision and radium.
- 1931. 2 of the patients treated in this year were treated by a combination of excision and radium. 1 of them has died from glandular metastasis.

ALVEOLUS

- 1926. Of the patients treated in this year those who died in the second year were in Stage III. The remaining patient was in Stage I.
- 1927. The patient who is untraced was Stage I. The other patient Stage III.
- 1928. This patient was in Stage I.
- 1929. This patient had a recurrence after previous operation and was treated by excision and insertion of radium.

GLANDS OF NECK

- 1925. All patients treated in this year were in Stage III. 1 patient who died in third year was treated by both radium and X-rays.
- 1926. All patients treated in this year were in Stage III. 1 patient who died in the second year was treated by both radium and X-rays.
- 1927. This patient was in Stage III.
- 1928. This patient was in Stage III. He was diagnosed as carcinoma of sub-maxillary salivary gland.
- 1929. 3 of the patients treated in this year were in Stage II. 1 of them who was alive in the beginning of 1932 was treated by excision and the insertion of radium.
- 1930. 1 of the patients treated in this year was in Stage II and was treated by excision followed by surface radiation. He died in 1931. The remainder were in Stage III.
- 1931. 1 of the patients treated in this year was in Stage II and was treated by excision followed by surface radiation. He was alive at the beginning of 1932. The remainder were in Stage III.

Disease. CARCINOMA OF THE PAROTID.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.						Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5	Cancer.			Other Causes.	
1925		1	1								1				1					
1926																				
1927		7	4	3	3	3	2	1			3	1			4	2				
1928		1	1	1	1	1										1				
1929		5	3	2	2						2	1			3	2				
1930		2	2	2												2				
1931		4	3							1					1	3				

*Disease. SARCOMA.*

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		11	7	6	4	4	4	1			3	1	2			6	4		
1926		13	5	5	2	2	2	2			5		3			8	3		
1927		9	9	5	5	4	2			1		3		1	2	6	2		
1928		14	8	3	2	1		2			5	5	1			11	1		
1929		23	17	11	6			3			6	6	2			14	6		
1930		4	4	1							3					3	1		
1931		9	9													9			

*Disease. CARCINOMA OF THE RECTUM.*

1925		5	2					3								2			
1926		1	1	1	1	1	1										1		
1927		5	1	1	1	1	1	3			1					1	1		
1928		14	10	5	2	1					4	5	3	1		13	1		
1929		5	3	2	2						2	1				3	2		
1930		6	6	4							2					2	4		
1931		2	1								1					1	1		

PAROTID

1925. 1 patient was treated with operation and radium. This patient died in 1926.  
 1927. 4 patients were treated by operation and radium. Of these: 2 were well at the end of 1930 and 1 at the beginning of 1932, the other being untraced. The remaining 2 died in 1927. 1 patient had radium to recurrence and was well in 1931.  
 1929. 1 patient was treated by operation and radium for recurrence and died in 1930.  
 1930. 1 patient was treated with radium for a recurrence and was well at the beginning of 1932.  
 1931. 2 patients were treated by operation and radium and were well at the beginning of 1932.

SARCOMA

1925. This year included in the sites affected the ilium, frontal sinus, arm, uterus, shoulder, maxilla, abdominal wall, orbit, thigh, larynx, and retroperitoneal sarcoma. The 2 alive at the beginning of 1932 were chondro-sarcoma of the ilium and sarcoma of the orbit, both of whom were treated by operation and radium. Of the remainder: 1 was treated by operation and radium and the rest by radium only.  
 1926. This year included in the sites affected, the maxilla, orbit, humerus (myeloma), ilium, thigh, forearm, tonsil, antrum, tibia, nose, and lympho-sarcoma. The 2 cases well at the beginning of 1932 were humerus (myeloma) treated by operation and radium, and sarcoma of the tibia. Of the remainder: 2 were treated by operation and radium, 1 being untraced and the other died in 1928. 2 cases were recurrences and lived till 1928.  
 1927. This year included in the sites affected, the tibia, ilium, leg, sternum, orbit,

- and lymphosarcoma and glioma. The 2 cases alive in the beginning of 1932 were glioma and sarcoma of leg. Both were treated by operation and radium. Of the remainder: 3 were treated by operation and radium, 1 died in 1928 and 2 died in 1931. The rest, including a recurrent case, were treated by radium only.
1928. This year included in the sites affected, the shoulder and mediastinum, arm, maxilla, humerus, thigh, mediastinum, ilium, neck, nasopharynx, and lymphosarcoma. 2 cases, arm and nasopharynx, were alive in 1930 and the latter alive in 1931. The former was untraced in 1931. Both had been treated by operation and radium. Of the remainder: 1, a recurrence, was treated by operation and radium and died in 1929. 2 other cases were recurrences, 1 being untraced and the other died in 1928.
1929. This year included in the sites affected, the shoulder, pelvis, femur, orbit, mesentery, humerus, tonsil, tibia, septum, buttock, eye, knee, cervical vertebra, mediastinum, orbit, and angiosarcoma. Of the 6 alive at the beginning of 1932, 1 had developed a recurrence, 4 of these had been treated by radium and operation and 2 by radium only. Of the remainder 6 had been treated by operation and radium. 1 case was well at the end of 1930 but untraced in 1931.
1930. This year included in the sites affected, the femur, ilium, orbit, and lymphosarcoma. 3 were treated by operation and radium. Of these 1 is alive at the beginning of 1932, 1 was treated by radium only.
1931. This year included in the sites affected, the sternum, femur, skull, abdominal wall, popliteal space, skin, rectum, orbit, and lymphosarcoma. 1 case was treated by operation and radium and was alive at the beginning of 1932. 2 cases were treated by radium and X-rays, of which 1 is well and 1 has a recurrence. The remainder were treated by radium only.

CARCINOMA OF THE RECTUM

1925. 1 patient who is untraced was treated by excision and insertion of radium.
1926. This patient was treated by excision and insertion of radium.
1927. The patient who remained alive at the beginning of 1932 was treated by excision and insertion of radium.
1928. 1 patient who died in the second year was treated by radium and excision was performed later. 1 patient who died in the third year was treated by radium for perineal post-operative recurrence.
1930. 1 patient who remained well at the beginning of 1932 was treated by excision and insertion of radium. 1 patient who remained well at the beginning of 1932 was treated by radium and the rectum was excised later.

Disease. CARCINOMA OF THE BREAST (PRIMARY).

Stage. All Stages.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		2	1					1				1			1				
1926		4	4	2									2	2		4			
1927		1										1			1				
1928		7	6	6	6	5						1		1		2	5		
1929		16	8	6	4			2				6	2	2		10	4		
1930		20	15	11				1	1			4	4			8	11		
1931		15	10									5				5	10		



## Stage I.

Year.	Total Treated.	Alice years after treatment.					Unruled at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
		1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925																		
1926																		
1927																		
1928	1	1	1	1	1	1									1			
1929	4	3	3	2			1					1			1	2		
1930	2							1		2					2			
1931	2	2													2			

## Stage II.

1925																	
1926																	
1927																	
1928	2	2	2	2	2										2		
1929	4	3	2	2					1	1					2	2	
1930	5	5	4							1					1	4	
1931	3	2							1						1	2	

## Stage III.

1925	2	1					1			1				1			
1926	4	4	2							2	2			4			
1927	1								1					1			
1928	4	3	3	3	2				1			1		2	2		
1929	8	2	1				1		5	1	1			7			
1930	13	10	7				1		2	3				5	7		
1931	10	6							4					4	6		

## BREAST (PRIMARY)

1928. Of the 2 patients in Stage II, 1 developed a recurrence in 1930 and a radical mastectomy was performed. This patient remained well at the beginning of 1932.
1929. Of the 4 patients in Stage I, 1 patient who had lesions in both breasts was later treated by double mastectomy. This patient remained alive at the beginning of 1932.
1931. 1 patient in Stage III who was still alive at the beginning of 1932 was treated by radium but the growth did not completely disappear and mastectomy was then performed.

*Disease. CARCINOMA OF THE BREAST (RECURRENT).*

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		17	11	5	4	3	2	2			4	6	1	1	1	13	1	1	
1926		19	13	8	3	3	3	3	1		3	5	5			13	1	2	
1927		13	10	4	2	1					3	6	2	1	1	13			
1928		19	16	12	6	2		1			2	4	6	4		16	2		
1929		17	10	4				1			6	6	4			16			
1930		16	12	7							4	5				9	7		
1931		5	5								.						5		

*Disease. CARCINOMA OF THE BLADDER AND PROSTATE.*

1925																		
1926		1	1								1					1		
1927		1	1	1	1	1								1	1			
1928		1	1	1								1				1		
1929		5	2					1		3	2					5		
1930		5	4	1						1	3					4	1	
1931		4	3							1						1	3	

*Disease. EPITHELIOMA OF THE PENIS.*

1925		1	1	1	1	1	1										1	
1926																		
1927		1	1	1	1								1			1		
1928																		
1929		3	3	3	3												3	
1930																		
1931		3	2					1								1	2	

## BREAST (RECURRENT)

1926. 1 patient who is untraced and 1 patient who died in the second year were treated by operation and the insertion of radium. 2 patients who died in the third year and 1 patient who remained well at the beginning of 1932 were treated by the insertion of radium and X-ray therapy.
1927. 1 patient who died in the second year was treated by the insertion of radium and injection of lead. 1 patient died in the second year, this patient was treated by radium and X-rays.
1928. 1 patient who died in the third year was treated by excision and the insertion of radium. 1 patient who remained well in 1932 was treated by radium and X-rays.

1929. 1 patient who died in the first year was treated by excision and the insertion of radium.  
 1930. 1 patient who died in the first year was treated by excision and the insertion of radium.

PENIS

1925. This patient was treated by excision and insertion of radium.  
 1927. This patient was treated by excision and insertion of radium.  
 1931. The patient marked 'Died of Operation' was treated by radium for epithelioma of penis but the growth was not sterilized. A radical operation was performed but the patient died.

BLADDER AND PROSTATE

1927. This patient was treated by excision and insertion of radium for carcinoma of prostate.  
 1928. This patient was treated by excision and insertion of radium for carcinoma of prostate.  
 1929. In this year 2 patients with carcinoma of bladder were treated by excision and insertion of radium. 1 died in the first year and 1 died in the second year.  
 1930. 1 patient who remained well at the beginning of 1932 was treated for carcinoma of bladder by excision and insertion of radium. 1 patient who died in the third year was treated for carcinoma of prostate by insertion of radium and X-ray therapy. 1 patient who died in the third year was treated for post-operative recurrence of carcinoma of bladder.  
 1931. 1 patient who remained alive in the beginning of 1932 was treated for carcinoma of prostate by excision and insertion of radium.

Disease. CARCINOMA OF THE LARYNX.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Undrained at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		4	1					2			1	1				2			
1926		7	1					3			3	1				4			
1927		6						1			5					5			
1928		7	1								6	1				7			
1929		7	3	1	1						4	2				6	1		
1930		14	7	4				1			6	3				9	4		
1931		8	6						1		2					2	6		

Disease. CARCINOMA OF THE NASO-PHARYNX AND PHARYNGEAL WALL.

1925		3	2	2	1	1	1	1					1			1			
1926		3	2	1				1			1	1				2			
1927		4	2					1	1		1	2				3			
1928		1									1					1			
1929		3	2								1	2				3			
1930		2	2									2				2			
1931		1	1														1		

## MEDICAL USES OF RADIUM

*Disease.* CARCINOMA OF THE OESOPHAGUS.

Year.	Total applying for Treatment.	Total Treated.	Alive years after treatment.					Untraced at 5 years.	Died of Operation.	Died of Other Causes 0-5 years.	Died of Cancer.					Total Died Cancer 0-5 years.	Alive 1932.	Died after 5 years.	
			1	2	3	4	5				0-1	1-2	2-3	3-4	4-5			Cancer.	Other Causes.
1925		4	1					1			3	1				4			
1926		10	4				3				3	4				7			
1927		10	1				4	2			5	1				6			
1928		13	3	2			3				7	1	2			10			
1929		25	9				2				14	9				23			
1930		15	11				1	1			4	10				14			
1931		17	6				1				10					10	6		

## LARYNX

The patients included in this classification are those who had lesions in the following situations:

- A. Intrinsic    1. Glottic  
                   2. Subglottic  
 B. Extrinsic    1. Epilaryngeal  
                   2. Vallecula and Epiglottis  
                   3. Pyriform fossa

1926. 1 patient with movable glands was treated by operation and insertion of radium. This patient is untraced.

1929. 1 patient, who was living at the beginning of 1932, received treatment for lesion of epiglottis. No glands were palpable in neck.

All the remaining patients were considered inoperable when treatment by radium was given.

## NASO-PHARYNX AND PHARYNGEAL WALL

1925. The patient marked living at the end of 5 years has not been traced since 1930, when he was attending another surgeon.

## OESOPHAGUS

1927. 1 patient was classed as 'myeloma'. This patient died in 1927.

1928. In this year there were 2 postcricoid cases. 1 is untraced, the other died in 1928.

1929. 2 patients received radium treatment via a thoracotomy operation. 1 died in 1929 and 1 in 1930. 7 postcricoid cases were treated. 5 died in 1929 and 2 in 1930.

1930. 1 postcricoid case was treated and died in 1931.

1931. 2 postcricoid cases were treated. 1 died in 1931. The other was well at the beginning of 1932.

## APPENDIX II

### *List of Research Centres and Local Committees.*

The centres taking part in the scheme covered by the foregoing Report are the institutions named below. Ten of these have continued to hold fractions of the stock of radium salt entrusted by H.M. Government to the Medical Research Council for the purposes of research into its medical uses. The list includes three additional centres, one of which has shared in a further quantity of radium provided by the British Empire Cancer Campaign for the extension of the scheme.

Most of these centres have also been able to draw upon a source of radium emanation ('radon') at the Middlesex Hospital: the salt required for this has been set aside from the Council's stock, accommodation for the work being provided by the courtesy of the Governor of the Hospital and expenses by the British Empire Cancer Campaign. Details of this arrangement were given in the Preface and Appendix to the Report for 1924 (No. 102).

The work of the different clinical centres is being done under the direction of the local research committees named in the following list. For the co-operation of these the Council again take the opportunity of making grateful acknowledgement.

#### **The Middlesex Hospital, London :**

G. Gordon-Taylor, O.B.E., M.S., B.Sc., F.R.C.S.; E. L. Pearce Gould, M.D., M.Ch., F.R.C.S.; R. V. Hudson, F.R.C.S.; E. W. Riches, M.C., M.S., F.R.C.S.; Victor Bonney, M.D., M.S., B.Sc., F.R.C.S.; C. P. Wilson, F.R.C.S.; C. E. Lakin, M.D., F.R.C.P., F.R.C.S.; J. H. Douglas Webster, M.D., M.R.C.P.; T. Izod Bennett, M.D., F.R.C.P.; A. E. Webb-Johnson, C.B.E., D.S.O., M.B., F.R.C.S.; B. W. Windeyer, M.B., F.R.C.S.E.; Professor James McIntosh, M.D.; Professor E. C. Dodds, M.V.O., M.D., Ph.D.; and Professor Sidney Russ, C.B.E., D.Sc.

#### **University College Hospital, London :**

A. M. H. Gray, C.B.E., M.D., F.R.C.P.; Gwynne Williams, M.S., F.R.C.S.; Professor A. E. Boycott, D.M., B.Sc., F.R.C.P., F.R.S.; Professor T. R. Elliott, C.B.E., D.S.O., M.D., F.R.C.P., F.R.S.; W. Trotter, M.S., F.R.C.S., F.R.S.; Professor C. C. Choyce, C.M.G., C.B.E., M.D., F.R.C.S.; E. K. Martin, M.S., F.R.C.S.; J. Taylor, O.B.E., M.S., F.R.C.S.; R. W. A. Salmond, O.B.E., M.D.; Professor F. J. Browne, M.D., D.Sc., F.R.C.S.E., F.C.O.G.; Clifford White, M.D., F.R.C.P., F.R.C.S., F.C.O.G.; H. A. Kisch, M.B., F.R.C.S.; J. W. McNee, D.S.O., M.D., D.Sc., F.R.C.P.; and Professor E. N. da C. Andrade, D.Sc., Ph.D.

#### **St. Bartholomew's Hospital, London :**

Sir Thomas Horder, Bart., K.C.V.O., M.D., F.R.C.P.; Sir Charles Gordon-Watson, K.B.E., C.M.G., F.R.C.S.; Professor G. E. Gask, C.M.G., D.S.O., F.R.C.S.; J. E. H. Roberts, O.B.E., F.R.C.S.; Geoffrey Keynes, M.D., F.R.C.S.; J. B. Hume, M.S., F.R.C.S.; G. Graham, M.D., F.R.C.P.; J. D. Barris, F.R.C.P., F.R.C.S.; Malcolm Donaldson, F.R.C.S.; W. Douglas Harmer, F.R.C.S.; H. G. Bedford Russell, F.R.C.S.; N. S. Finzi, M.B., D.M.R.E.; Walter M. Levitt, M.B., D.M.R.E.; Professor E. H. Kettle, M.D.; W. Girling Ball, F.R.C.S.; R. G. Canti, M.D.; and Professor F. L. Hopwood, D.Sc.

**King's College Hospital, London :**

H. C. Edwards, M.S., F.R.C.S.; W. Gilliatt, M.D., F.R.C.S.; J. B. Hunter, M.C., M.Ch., F.R.C.S.; V. E. Negus, M.S., F.R.C.S.; R. M. Saunders, M.B., Ch.B.; M. S. Thomson, M.D., M.R.C.P.; and G. P. G. Wakeley, F.R.C.S., F.R.S.E.

**St. Peter's Hospital, London :**

J. Swift Joly, M.D., F.R.C.S.; A. Clifford Morson, F.R.C.S.; F. J. F. Barrington, M.S., F.R.C.S.; R. Ogier Ward, M.Ch., F.R.C.S.; J. Alban Andrews, Ch.B., F.R.C.S.; and John Sandrey, M.B., Ch.M., F.R.C.S.

**Marie Curie Hospital, London :**

Miss M. M. Chadburn, M.D., B.S.; Lady Barrett, C.H., C.B.E., M.D., M.S.; Lady Briscoe, M.B., B.S.; Miss H. Chambers, C.B.E., M.D.; Miss E. Hurdon, M.D., C.M. (Tor.); Professor Dame Louise McIlroy, D.B.E., M.D., D.Sc.; Miss E. Magill, O.B.E., M.B.; Miss L. Martindale, C.B.E., J.P., M.D.; Miss K. Platt, M.D., B.S.; and Miss M. Rawlins, M.B., B.S.

**St. Mark's Hospital, London :**

P. Lockhart-Mummery, F.R.C.S.; Sir Charles Gordon-Watson, K.B.E., C.M.G., F.R.C.S.; Lionel E. C. Norbury, O.B.E., M.B., F.R.C.S.; W. B. Gabriel, M.S., F.R.C.S.; E. T. C. Milligan, O.B.E., M.D., F.R.C.S.; C. Naunton Morgan, M.B., F.R.C.S.; and Cuthbert Dukes, O.B.E., M.D., M.Sc., D.P.H.

**Royal Free Hospital, London :**

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(The salt allocated to the last-named centre has been used as a source of emanation for distribution in Ireland.)

In addition, fractions of radium salt have been lent for research by Dr. J. C. Mottram, Mount Vernon Hospital, Northwood, and by Mr. Geoffrey Jefferson, F.R.C.S., Royal Infirmary, Manchester.

The radium lent to the Council last year by the National Radium Commission has been allocated to the Scottish Branch of the Medical Women's Federation, Edinburgh, the Royal Free Hospital, London, and to the Strangeways Research Laboratory, Cambridge. Fractions of it have also been lent for purely experimental work in Professor D. P. D. Wilkie's Department, at Edinburgh, and by Dr. Muriel Robertson at the Lister Institute, London.

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In addition, numerous memoirs upon work aided by the Medical Research Council have appeared in Scientific Journals: particulars of these may be seen in the Annual Reports.

### ANNUAL REPORTS

Medical Research Committee, Nos. 1-5, 1914-15 to 1918-19.

Medical Research Council, 1919-20 to 1929-30.

(Price of each report from 1920-1 to 1925-6, 8s. 6d. (3s. 8d.); from 1926-7 to 1928-9, 3s. (3s. 2d.); 1929-30 and 1930-31, 2s. 6d. (2s. 8d.).)

### SPECIAL REPORTS, &c.

#### Alcohol :

No. 31. Alcohol: its Absorption into and Disappearance from the Blood under different conditions. By E. Mellanby. [1919.] *Out of print.*

No. 34. The Influence of Alcohol on Manual Work and Neuro-muscular Co-ordination. By H. M. Vernon. [1919.] 2s. (2s. 1d.).

No. 56. The Effects of Alcohol and some other Drugs during Normal and Fatigued Conditions. By W. McDougall and May Smith. [1920.] 1s. (1s. 1d.).

No. 168. Alcohol and Inheritance: An Experimental Study. By F. M. Durham and H. M. Woods. [1932.] 1s. 3d.

(Book). Alcohol: its Action on the Human Organism. Second Edition. [1924.] 1s. paper covers, 1s. 6d. cloth bound.

#### Anaerobic Bacteria : see WOUND INFECTIONS.

#### Animals, Diseases of :

No. 121. Borna Disease and Enzootic Encephalo-Myelitis of Sheep and Cattle. By S. Nicolau and I. A. Galloway. [1928.] 5s. (5s. 2½d.).

#### Bacteriology (MISCELLANEOUS):

No. 35. The Reaction of Culture Media, by S. R. Douglas, J. W. H. Eyre, P. P. Laidlaw, and C. G. L. Wolf. Second Edition, revised by P. P. Laidlaw. [1927.] 6d. (7d.).

No. 49. On the Destruction of Bacteria in Milk by Electricity. By J. M. Beattie and F. C. Lewis. [1920.] *Out of print.*

No. 51. The Laboratory Diagnosis of Acute Intestinal Infections, including the Principles and Practice of the Agglutination Tests. By the Committee upon Pathological Methods. [1920.] 4s. 6d. (4s. 8d.).

No. 64. Catalogue of the National Collection of Type Cultures. Third Edition. [1931.] 2s. (2s. 1d.).

No. 169. The Haemolytic Streptococci: Their Grouping by Agglutination. By F. W. Andrewes and Ethel M. Christie. [1932.] 1s. 3d. (1s. 4½d.).

See also SURGERY (No. 138).

A SYSTEM OF BACTERIOLOGY IN RELATION TO MEDICINE. (See p. x.)

#### Blood Physiology :

No. 72. The Acid-base Equilibrium of the Blood. By the Haemoglobin Committee. [1923.] 2s. (2s. 1d.).

See also SHOCK, SURGICAL.

#### Borna Disease : see ANIMALS, DISEASES OF.

\* For overseas agencies see p. ix.



## Special Reports—continued.

**Brain Surgery:** *see* SURGERY.

**Bright's Disease:** *see* NEPHRITIS.

**Burns:**

No. 141. The Tannic Acid Treatment of Burns. By W. C. Wilson. [1929.] 1s. (1s. 1d.).

**Cancer:**

No. 99. An Investigation into the Statistics of Cancer in Different Trades and Professions. By Matthew Young and W. T. Russell. [1926.] 1s. 6d. (1s. 7d.).

*See also* RADIUM.

**Catgut:** *see* SURGERY (No. 138).

**Cerebro-spinal Fever:**

No. 2. Report of the Special Advisory Committee upon Bacteriological Studies of Cerebro-spinal Fever during the Epidemic of 1915. [1916.] *Out of print.*

No. 3. Bacteriological Studies in the Pathology and Preventive Control of Cerebro-spinal Fever among the Forces during 1915 and 1916. By M. H. Gordon, Martin Flack, P. W. Bassett-Smith, T. G. M. Hine, and W. J. Tulloch. [1917.] *Out of print.*

No. 17. (I.) A Report upon the Seasonal Outbreak of Cerebro-spinal Fever in the Navy at Portsmouth, 1916-17. By Paul Fildes and S. L. Baker. (II.) The Treatment of Cerebro-spinal Meningitis by Antimeningococcus Serum at the Royal Naval Hospital, Haslar, 1915-16-17. By G. P. Adshead. [1918.] 2s. 6d. (2s. 8½d.).

No. 50. Cerebro-spinal Fever. Studies in the Bacteriology, Preventive Control, and Specific Treatment of Cerebro-spinal Fever among the Military Forces, 1915-19. By M. H. Gordon and others. [1920.] 4s. (4s. 3d.).

No. 124. The Meningococcus. By E. G. D. Murray. [1929.] 3s. 6d. (3s. 8½d.).

**Chemotherapy:** *see* STREPTOCOCCAL INFECTIONS.

**Child Life (ANTENATAL AND POSTNATAL INVESTIGATIONS):**

No. 10. The Mortalities of Birth, Infancy, and Childhood. By A. K. Chalmers, W. A. Brend, L. Findlay, and J. Brownlee. [1918.] 1s. 6d. (1s. 7½d.).

No. 74. The Relation between Home Conditions and the Intelligence of School Children. By L. Isserlis. [1923.] 1s. (1s. 1d.).

No. 81. The Effect of Maternal Social Conditions and Nutrition upon Birth-weight and Birth-length. By M. Bruce Murray. [1924.] 1s. (1s. 1d.).

No. 82. Maternal Syphilis as a cause of Death of the Foetus and of the New-born Child. By J. N. Cruickshank. [1924.] 1s. 6d. (1s. 7½d.).

No. 86. The Estimation of Foetal Age, the Weight and Length of Normal Foetuses, and the Weights of Foetal Organs. By J. N. Cruickshank, M. J. Miller, and F. J. Browne. [1924.] 2s. 6d. (2s. 7½d.).

No. 101. Poverty, Nutrition, and Growth: Studies of Child Life in Cities and Rural Districts of Scotland. By D. Noël Paton, Leonard Findlay, and others. [1926.] 10s. (10s. 4½d.).

No. 109. A Clinical and Pathological Study of 1,673 Cases of Dead-Births and Neo-natal Deaths. Compiled by E. L. Holland and J. E. Lane-Clayton. [1926.] 3s. 6d. (3s. 7½d.).

No. 114. Social Conditions and Acute Rheumatism. [1927.] 2s. 6d. (2s. 8d.).

No. 117. The Toxaemias of Pregnancy: A Clinical and Biochemical Study. By J. N. Cruickshank, J. Hewitt, and K. L. Couper. [1927.] 4s. (4s. 2d.).

No. 118. The Cause of Foetal Death in 144 Cases. By A. C. Palmer. [1928.] 3s. (3s. 2d.).

No. 145. The Causes of Neo-natal Death. By J. N. Cruickshank. [1930.] 1s. 6d. (1s. 7½d.).

No. 157. Nutritional Anaemia in Infancy: The Influence of Iron Deficiency on Infant Health. By H. M. M. Mackay, L. Goodfellow, and A. Bradford Hill. [1931.] 2s. (2s. 2d.).

No. 162. Intelligence and Disease. By Shepherd Dawson assisted by J. C. M. Conn. [1931.] 1s. (1s. 1½d.).

No. 171. Facial Growth in Children, with Special Reference to Dentition. Part I by Corisande Smyth. Part II by Matthew Young. [1932.]

*See also* NUTRITION; RICKETS.

**Dental Disease:**

No. 70. The Structure of Teeth in relation to Dental Disease. By J. Howard Mummery. [1922.] 2s. (2s. 1d.).

### Special Reports—continued.

- No. 97. The Incidence of Dental Disease in Children. By the Committee for the Investigation of Dental Disease. [1925.] 1s. 6d. (1s. 7½d.).
- No. 140. Diet and the Teeth: An Experimental Study. Part I. Dental Structure in Dogs. By May Mellanby. [1920.] 17s. 6d. (18s.).
- No. 153. Diet and the Teeth: An Experimental Study. Part II. A. Diet and Dental Disease. B. Diet and Dental Structure in Mammals other than the Dog. By May Mellanby. [1930.] 2s. 6d. (2s. 8½d.).
- No. 159. The Influence of Diet on Caries in Children's Teeth (Interim Report). By the Dental Committee. [1931.] 6d. (7d.).
- See also* CHILD LIFE (No. 171).

#### Diphtheria :

- No. 115. The Prevention of Diphtheria. By J. Graham Forbes. [1927.] 2s. (2s. 1½d.).
- (Book). Diphtheria: its Bacteriology, Pathology, and Immunology. By the Bacteriological Committee. [1928.] 12s. 6d. (13s. 3d.).
- See also* EPIDEMIOLOGY (No. 75), STATISTICS (No. 137).

#### Dysentery :

Reports upon Investigations in the United Kingdom of Dysentery Cases received from the Eastern Mediterranean:—

- No. 4. I. Amoebic Dysentery and the Protozoological Investigation of Cases and Carriers. By Clifford Dobell. [1917.] *Out of print.*
- No. 5. II. Report upon 878 Cases of Bacillary Enteritis. By L. Rajchman and G. T. Western. [1917.] *Out of print.*
- No. 6. III. Report upon recovered Cases of Intestinal Disease in the Royal Naval Hospital, Haslar, 1915-16. By Paul Fildes and others. IV. Report upon combined Clinical and Bacteriological Studies of Dysentery Cases from the Mediterranean. By S. R. Douglas and L. Colebrook. [1917.] 4s. 6d. (4s. 7½d.).
- No. 7. V. Report upon 2,360 Enteritis 'Convalescents' received at Liverpool from various Expeditionary Forces. By E. Glynn and others. [1918.] 2s. (2s. 2d.).
- No. 15. A Study of 1,300 Convalescent Cases of Dysentery from Home Hospitals: with special reference to the Incidence and Treatment of Amoebic Dysentery Carriers. By Clifford Dobell, H. S. Gettings, Margaret W. Jepps, and J. B. Stephens. [1918.] 1s. 3d. (1s. 4d.).
- No. 29. A Contribution to the Study of Chronicity in Dysentery Carriers. By W. Fletcher and Doris L. Mackinnon. [1919.] 9d. (10d.).
- No. 30. An Investigation of the Flexner-Y Group of Dysentery Bacilli. By H. S. Gettings. [1919.] 1s. (1s. 1d.).
- No. 40. Studies of Bacillary Dysentery occurring in the British Forces in Macedonia. By L. S. Dudgeon and others. [1919.] 3s. (3s. 1½d.).
- No. 42. A Study of the Serological Races of the Flexner Group of Dysentery Bacilli. By F. W. Andrewes and A. C. Inman. [1919.] 2s. (2s. 1½d.).
- See also* FOOD POISONING.

#### Encephalitis :

- No. 108. The Sheffield Outbreak of Epidemic Encephalitis in 1924. [1926.] 1s. 9d. (1s. 10½d.).

#### Enteric Infections :

- No. 9. A Report upon the Use of Atropine as a Diagnostic Agent in Typhoid Infections. By H. F. Marris. [1917.] 1s. (1s. 1d.).
- No. 48. A Report on the probable Proportion of Enteric Infections among Undiagnosed Febrile Cases invalided from the Western Front since October 1916. By W. W. C. Topley, S. G. Platts, and C. G. Imrie. [1920.] 3s. (3s. 1½d.).
- See also* BACTERIOLOGY ; FOOD POISONING.

#### Epidemiology :

- No. 75. The Schick Test, Diphtheria and Scarlet Fever. By S. F. Dudley. [1925.] 1s. (1s. 1½d.).

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No. 111. The Spread of Droplet Infection in Semi-isolated Communities. By S. F. Dudley. [1926.] 1s. 6d. (1s. 7½d.).

No. 120. An Inquiry into the Relationship between Housing Conditions and the Incidence and Fatality of Measles. By J. L. Halliday. [1928.] 1s. (1s. 1d.).

*See also* SMALL-POX ; STATISTICS ; TUBERCULOSIS ; etc.

### Flying, Medical Problems of :

Reports of the Air Medical Investigation Committee:—

No. 28. The Sense of Balance and Stability in the Air. By Henry Head. [1919.] 9d. (10d.). (Included in No. 53.)

No. 37. The Effects of Diminished Tension of Oxygen, with especial reference to the Activity of the Adrenal Glands. By C. H. Kellaway. The Ear in relation to certain Disabilities in Flying. By S. Scott. [1919.] 1s. (1s. 1d.).

No. 53. The Medical Problems of Flying (including reports on oxygen want, selection of candidates for flying, sense of balance, and flying strain). [1920.] 6s. (6s. 4d.).

No. 84. The Application of the Air Force Physical Efficiency Tests to Men and Women. By L. D. Cripps. [1924.] 1s. 6d. (1s. 7½d.).

### Food Poisoning:

No. 24. A Report on the Investigation of an Epidemic caused by *Bacillus aertrycke*. By H. Marrian Perry and H. L. Tidy. [1919.] 9d. (10d.).

No. 91. An Investigation of the Salmonella Group, with Special Reference to Food Poisoning. By W. G. Savage and P. Bruce White. [1925.] 3s. 6d. (3s. 8d.).

No. 92. Food Poisoning: a Study of 100 Recent Outbreaks. By W. G. Savage and P. Bruce White. [1925.] 2s. 6d. (2s. 8d.).

No. 103. Further Studies of the Salmonella Group. By P. Bruce White. [1926.] 5s. (5s. 2½d.).

### Goitre:

No. 154. Iodine Supply and the Incidence of Endemic Goitre. By J. B. Orr. [1931.] 4d. (5d.). *See also* NUTRITION (No. 123).

**Haemoglobin:** *see* BLOOD.

### Hearing:

No. 166. Reports of the Committee on the Physiology of Hearing. I. The Localization of Sounds in the Median Plane. By J. H. Shaxby and F. H. Gage. II. Some Factors in Auditory Localization. By H. E. O. James and Marion E. Massey. [1932.] 1s. (1s. 1½d.).

### Heart:

No. 8. Report upon Soldiers returned as Cases of 'Disordered Action of the Heart' (D.A.H.), or Valvular Disease of the Heart. By Sir Thomas Lewis. [1917.] 1s. (1s. 1d.).

No. 147. The Electrocardiogram. By W. H. Craib. [1930.] 1s. 3d. (1s. 4½d.).

### Industrial Health:

The Annual Reports of the Industrial Health (formerly Fatigue) Research Board, and special reports on particular subjects, are published for the Council in separate series. The subjects dealt with include accident causation, rest pauses, spells of work, movement study, vocational selection, and problems of particular industries. A list can be supplied on application to the Secretary of the Board, 38 Old Queen Street, Westminster, S.W. 1.

### Influenza:

No. 36. Studies of Influenza in Hospitals of the British Armies in France, 1918. [1919.] 3s. 6d. (3s. 8d.).

No. 63. Studies in the Aetiology of Epidemic Influenza. By J. McIntosh. [1922.] 2s. 6d. (2s. 7d.).

### Jaundice:

No. 113. Spirochaetal Jaundice. By G. Buchanan. [1927.] 4s. (4s. 2d.).

### Light Treatment:

No. 131. Irradiation and Health. Two Experimental Studies. By Dora Colebrook. [1929.] 1s. 6d. (1s. 7d.).

**Malaria:** *see* QUININE.

## Special Reports—*continued.*

**Maternal Mortality :** *see* CHILD LIFE and STREPTOCOCCAL INFECTIONS.

**Measles :** *see* EPIDEMIOLOGY (No. 120).

**Miners' Dietaries :** *see* NUTRITION.

**Miners' Diseases, etc. :**

No. 89. Report on Miners' 'Beat Knee', 'Beat Hand', and 'Beat Elbow'. By E. L. Collis and T. L. Llewellyn. [1924.] 1s. 6d. (1s. 7d.).

*See also* JAUNDICE (No. 118).

**Miners' Nystagmus :** *see* VISION.

**Nephritis :**

No. 43. Albuminuria and War Nephritis among British Troops in France. By H. MacLean. [1919.] 2s. 6d. (2s. 8d.).

No. 142. A Classification of Bright's Disease. By Dorothy S. Russell. [1929.] 8s. 6d. (8s. 10d.).

**Nerve Injuries :**

Reports of the Committee upon Injuries to the Nervous System:—

No. 54. The Diagnosis and Treatment of Peripheral Nerve Injuries. [1920.] 2s. (2s. 1½d.).

No. 88. Injuries of the Spinal Cord and Cauda Equina. [1924.] 1s. 6d. (1s. 7½d.).

**Nutrition :**

No. 13. An Enquiry into the Composition of Dietaries, with special reference to the Dietaries of Munition Workers. By Viscount Dunluce and Major Greenwood.

*Out of print.*

No. 87. Report on the Nutrition of Miners and their Families. By the Committee upon Quantitative Problems in Human Nutrition. [1924.] 1s. 8d. (1s. 4d.).

No. 105. Diets for Boys during the School Age. By H. C. Corry Mann. [1920.] 2s. 6d. (2s. 7½d.).

No. 123. Iodine in Nutrition: a Review of Existing Information. By J. B. Orr and I. Leitch. [1929.] 2s. 6d. (2s. 8d.). *See also* GORRAE (No. 154).

No. 135. The Carbohydrate Content of Foods. By R. A. McCance and R. D. Lawrence. [1929.] 2s. (2s. 1½d.).

No. 146. The Antiscorvy Vitamin in Apples. By Mary F. Bracewell, E. Hoyle, and S. S. Zilva. [1930.] 9d. (10d.).

No. 151. A Study in Nutrition. An Inquiry into the Diet of 154 Families of St. Andrews. By E. P. Cathcart and A. M. T. Murray, assisted by M. Shanks. [1931.] 1s. (1s. 1½d.).

No. 155. Studies of Nutrition: The Physique and Health of Two African Tribes. By J. B. Orr and J. L. Gilks. [1931.] 2s. (2s. 2d.).

No. 158. The Quantitative Estimation of Vitamin D by Radiography. By R. B. Bourdillon, H. M. Bruce, C. Fischmann, and T. A. Webster. [1931.] 1s. (1s. 1½d.).

No. 165. Studies in Nutrition. An Inquiry into the Diet of Families in Cardiff and Reading. By E. P. Cathcart and A. M. T. Murray, assisted by M. Shanks. [1932.] 6d. (7d.).

No. 167. Vitamins: A Survey of Present Knowledge. By a Committee appointed jointly by the Lister Institute and Medical Research Council. [1932.] 6s. 8d. (7s. ½d.).

No. 175. Vitamin Content of Australian, New Zealand and English Butters. By M. E. F. Crawford, E. O. V. Perry, and S. S. Zilva. [1932.]

*See also* CHILD LIFE; RICKETS; DENTAL DISEASE.

**Pituitary Extract :** *see* STANDARDS.

**Pneumonia :**

No. 79. Bacteriological and Clinical Observations on Pneumonia and Empyemata, with special reference to the Pneumococcus and to Serum Treatment. By E. E. Glynn and Lettice Digby. [1923.] 5s. (5s. 3d.).

**Pneumothorax, Artificial :** *see* TUBERCULOSIS.

**Print, Legibility of :** *see* VISION.

**Protozoan Infections :**

No. 59. A Report on the Occurrence of Intestinal Protozoa in the inhabitants of Britain. By Clifford Dobell. [1921.] 2s. (2s. 1½d.).

**Psychology :**

No. 170. Studies in the Psychology of Delinquency. By G. W. Pailthorpe. [1932.] 2s. (2s. 2d.).

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### Quinine :

- No. 96. Clinical Comparisons of Quinine and Quinidine. By the Committee upon Cinchona Derivatives and Malaria. [1925.] 1s. (1s. 1d.).

### Radium :

- No. 62. Medical Uses of Radium : Studies of the Effects of Gamma Rays from a large Quantity of Radium. By various authors. [1922.] 5s. (5s. 3d.).
- No. 90. Medical Uses of Radium : Summary of Reports from Research Centres for 1923. [1924.] 1s. (1s. 1d.).
- No. 102. Ditto for 1924. [1926.] 1s. 6d. (1s. 7d.).
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- No. 160. Ditto for 1930. [1931.] 1s. (1s. 1d.).
- No. 174. Ditto for 1931. [1932.]

Rheumatism : *see* CHILD LIFE (No. 114).

### Rickets :

- No. 20. A Study of Social and Economic Factors in the Causation of Rickets, with an Introductory Historical Survey. By L. Findlay and Margaret Ferguson. [1918.] *Out of print.*
- No. 61. Experimental Rickets. By E. Mellanby. [1921.] 4s. (4s. 2d.).
- No. 68. Rickets : the Relative Importance of Environment and Diet as Factors in Causation. By H. Corry Mann. [1922.] 2s. 6d. (2s. 7½d.).
- No. 71. The Aetiology and Pathology of Rickets from an experimental point of view. By V. Korenchevsky. [1922.] 4s. (4s. 3d.).
- No. 77. Studies of Rickets in Vienna, 1919-22. [1923.] 7s. 6d. (7s. 10½d.).
- No. 98. Experimental Rickets : The Effect of Cereals and their Interaction with other factors of Diet and Environment in producing Rickets. By E. Mellanby. [1925.] 3s. 6d. (3s. 8d.).

Salvarsan : *see* VENEREAL DISEASES ; STREPTOCOCCAL INFECTIONS ; STANDARDS, BIOLOGICAL (No. 128).

Scarlet Fever : *see* STATISTICS (No. 137).

Scurvy : *see* NUTRITION (No. 146).

### Shock, Surgical :

Reports of the Committee on Surgical Shock and Allied Conditions:—

- No. 25. Wound-Shock and Haemorrhage. [1919.] 4s. (4s. 5½d.).
- No. 26. Traumatic Toxaemia as a Factor in Shock. [1919.] 1s. (1s. 1d.).
- No. 27. Blood Volume Changes in Wound-Shock and Primary Haemorrhage. By N. M. Keith. [1919.] 9d. (10d.).

### Small-pox :

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