

## MEDICAL USES OF RADIUM

**Privy Council**

**MEDICAL RESEARCH  
COUNCIL**

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**MEDICAL USES OF RADIUM**  
**Summary of Reports from Research  
Centres for 1932**



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## PREFACE

THIS report summarizes the results of research work done during 1932 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 ten similar reports already published (Nos. 62, 90, 102, 112, 116, 126, 144, 150, 160, and 174 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 section in which some account of purely experimental investigations is presented.

MEDICAL RESEARCH COUNCIL,  
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27th July, 1933.

# MEDICAL USES OF RADIUM

Summary of Reports from Research Centres for 1932

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## INTRODUCTION

THE presentation of the subject-matter of the present report follows the lines of previous issues. The general balance of these reports must inevitably shift as knowledge of the subject advances. Earlier reports in this series were largely concerned with details of new developments in radio-therapeutic technique, but the stage is now reached where there is less of this information from the centres, for there are few sites of the body liable to the incidence of malignant disease which have not already been studied from this point of view. On the other hand, the statistical information has gained in value, as it now covers a large enough number of years to provide data from which conclusions can be drawn with some certainty.

More experimental work in radiology is done in physical, biological, and pathological laboratories at the present time than ever before. This has been a gradual growth at many of the research centres, but of late years there have been several additions to these, and the general experimental facilities for research into the nature of the actions of radium upon normal and malignant structures of the body have received a great stimulus by the allocation of radium from the Radium Commission to the Council for work of this character.

The treatment of carcinoma of the rectum by irradiation has till lately been disappointing, but there are now indications that, with greater experience and better understanding of the dosage, the future holds out a more favourable prospect. It is, therefore, of the utmost importance that new radium methods of treatment should be explored, for it points to the fact that although for many years these growths have been looked upon as hopeless or as radio-resistant, some have

responded well to treatment, with the result that patients are alive a number of years afterwards.

With larger quantities of radium available for treatment there is a definite advance in the methods of applying comparatively large quantities externally to the body, and just as with X-rays, so with gamma radiation the tolerance of the skin may be said to limit the dose which may be given by any one port of entry to any region of the body in this way. It has been known for more than 20 years that the dose of radiation that the normal skin will tolerate is dependent on the time over which that dose is spread, and that the longer the time-interval is made the bigger is the dose that can be tolerated. The tolerance of the skin, however, is not quite such a simple matter as this, for if the skin be looked upon as an organ of the body then a study of its toleration linked up with its physiological state may exhibit other important variables. And this is borne out by several papers in the present summary, from which it would appear that the tolerance of the skin depends upon the region of the body which it covers and on its own blood-supply.

It is not always recognized that the reactions of the normal skin to irradiation are in many important clinics made the actual basis for the doses used in the treatment, so that the dose of X-rays or gamma rays being given to a malignant growth will be expressed in terms of the skin erythema dose (S.E.D.). Such a method of reference has an obvious convenience once the normal S.E.D. is fixed in terms of some reproducible physical quantity, but the practice is a very risky one if serious doubt may be cast on the reliability of this quantity, the S.E.D. It is consequently of the greatest importance to see to what extent these new observations warrant the importance which may, from some points of view, be attached to them. In a report from the Manchester Royal Infirmary and Holt Radium Institute, where an investigation is being continued on the treatment of brain tumours, the authors state that as a result of their own observations, they have come to the conclusion that the toleration of the skin of the scalp is about 50 per cent. greater than the skin tolerance in other regions of the body. In this instance the other regions of the body are grouped as if they all reacted to the same degree.

In a communication from Dr. J. C. Mottram a number of observations are collected with reference to the toleration of the skin in its relationship to the blood-supply, and the conclusion is drawn by him that regions of the skin with a depleted blood-supply react less to radium exposures than do the normal areas. Again, observation of the reaction of the skin of the face and neck exposed to external sources of gamma rays show that the skin of the face is apparently more sensitive than the skin of the neck. These three instances will be quite enough to show how one type of investigation helps on many varieties of therapy, for if the skin is in any way a typical organ of the body it means that we must look for similar differences to exhibit themselves throughout the body, and that the reactions to irradiation of a patient suffering from malignant disease is not simply a question of the

direct action of irradiation upon the tumour, but also a question of the general physiological response of the individual as a whole.

Other experimental work which is summarized in the present issue is largely concerned with studies of cellular reactions of a fundamental character. It may be some time before the results of these studies become in any way clear in their application to malignant disease, but if X-ray and radium therapy are to be shorn of the empiricism which has been alleged against them it can only be by investigations which seek in their several ways to give us more information about the processes which are set into operation by irradiation.

Following the practice of the last two years, data have been collected from various centres on the relative frequency of surgical and radiological treatment for patients suffering from malignant disease. Relevant data have been received from the following institutions: Aberdeen Royal Infirmary, Cardiff Royal Infirmary, Irish Radium Centre, Marie Curie Hospital, Middlesex Hospital, Royal Free Hospital, St. Bartholomew's Hospital, St. Peter's Hospital, the Scottish Associations of the Women's Medical Federation, and University College Hospital. The data are collected in Table 1.

TABLE 1.

*Relative Frequency of Surgical and Radiological Treatment.*

<i>Treatment.</i>	<i>Number treated (1932).</i>	<i>Percentage of total number treated.</i>
By all methods . . . . .	2,172	100.0
By surgery alone . . . . .	560	25.8
By radium alone <sup>1</sup> . . . . .	904	44.4
By X-rays alone . . . . .	224	10.3
By surgery+radium . . . . .	153	7.0
By surgery+X-rays . . . . .	127	5.9
By radium+X-rays . . . . .	131	6.0
By surgery+radium+X-rays . . . . .	13	0.6

<sup>1</sup> Treatment by 'radium alone' may involve surgery of access.

Collecting the data of a similar character for the years 1930, 1931, and 1932, it is found that at those Council's centres which have contributed to the collection of this information, 5,520 patients suffering from malignant disease have been treated. Of these, 1,721 have been treated by means of surgery alone, making 31 per cent., and 2,175 have been treated by means of radium alone, making 39 per cent. These numbers are perhaps big enough to warrant the conclusion that it represents the relative probabilities at important medical centres in many other parts of the country.

The report from University College Hospital has already been published *in extenso* under the following title: *Report on Radiotherapy for 1932*, by John Bale, Sons & Danielsson, Ltd.

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, D.

## A. CANCER OF THE BREAST

## TECHNIQUE.

The report from ABERDEEN ROYAL INFIRMARY states that, as foreshadowed in last year's report, wherever possible the aim has been to give either a two or three-stage treatment in cases of Carcinoma Mammae. As far as possible this is being carried out. Detailed histological examination of breasts amputated after irradiation is being made. The report contains the following interesting details of seven cases treated:

1. Mrs. B. S. aet. 36.  
 Clinical diagnosis. Duct carcinoma of the breast, glands not palpable.  
 February, 1932. Radical needling.  
 Six weeks later. Complete disappearance of lump.  
 January, 1933. Local removal of the breast with diathermy current.  
 Histological examination. No tumour cells found in breast.  
 March, 1933. Alive and well, no signs of malignant disease.
2. Mrs. M. L. aet. 64.  
 Clinical diagnosis. Scirrhous cancer, glands not palpable.  
 April, 1931. Radical needling.  
 May, 1931. Radical amputation.  
 Histological examination. Small area of greatly degenerated tumour cells.  
 Stroma packed with active fibroblasts, to some extent concentric arranged around groups of degenerated tumour cells. No evidence of malignant disease in axillary contents.  
 August, 1931. Subsequent surface irradiation given.  
 March, 1933. Alive and well.
3. Mrs. J. L. aet. 49.  
 Clinical diagnosis. Scirrhous cancer. No palpable glands.  
 March, 1931. Radical needling.  
 May, 1931. Surface irradiation.  
 September, 1931. Local amputation of breast.  
 Histological examination. No evidence of tumour; only fibrous tissue seen in sections.  
 March, 1933. Alive and well.
4. Miss L. F. aet. 22.  
 Clinical diagnosis. Early carcinoma of the right breast. Palpable glands in both axillae. Both breasts the seat of chronic mastitis.  
 May, 1931. Radical needling.  
 October, 1931. Local amputation of breast.  
 Histological examination. No tumour cells. Normal breast tissue mostly replaced by hyaline fibrous tissue.  
 March, 1933. Alive and well.
5. Mrs. A. M. aet. 60.  
 Clinical diagnosis. Scirrhous cancer, glands palpable in axilla.  
 July, 1931. Radical needling.  
 November, 1931. Radical amputation.  
 Histological examination. Breast: no tumour cells found.  
 Axilla: small areas of spheroidal cancer cells survive, but these cells are greatly degenerated.  
 Patient did not return for surface irradiation.



- April, 1932. Re-admitted. Extensive ulceration of wall of chest with involvement of supraclavicular glands. Operation scar infiltrated with growth.
- August, 1932. Dead.
6. Mrs. C. T. aet. 55.  
Clinical diagnosis. Scirrhus cancer. Palpable glands in the axilla.  
December, 1931. Radical needling, followed a fortnight later by radical amputation.  
Histological examination of breast tissue only. Tumour cells found in groups mostly exhibiting extreme degeneration. Connective tissue shows more active fibroblastic proliferation near the tumour cells than elsewhere. No mitoses.  
December, 1932. Alive and well.
7. Mrs. I. F. aet. 52.  
Clinical diagnosis. Scirrhus cancer. Axillary glands not palpable.  
March, 1931. Radical needling.  
April, 1931. Local amputation of breast.  
Histological examination. Breast: mostly fibrous tissue, one small deep nodule in the breast showed very small foci of degenerated tumour cells encapsulated in hyaline fibrous tissue such as seen elsewhere in the breast.  
June, 1931. Surface irradiation.  
March, 1933. Alive and well.

At the **CARDIFF ROYAL INFIRMARY** radical amputation is still the routine method adopted for the treatment of operable or borderline carcinoma of the breast. In the majority of cases this is followed by a surface prophylactic radiotherapy in a few weeks following amputation. Nine cases were treated solely with radium, 4 of these were operable or borderline cases. One died, and the remaining 3 are free from disease. Seventeen post-operative recurrences were further treated, the majority receiving surface radiotherapy. Three cases treated in this way were free from symptoms at the end of the year. Where radium alone has been used in operable and inoperable carcinomata of the breast, the results are satisfactory and compare well with the operative treatment during the year.

At the **MARIE CURIE HOSPITAL** the general technique for the treatment of cancer of the breast is the same.

Operable cases wherever possible have been treated by surgery. . . . The few operable cases treated by radiotherapy were in patients of very advanced age, or operation was refused—16 cases. Nineteen primary cases and 26 recurrent after operation have been treated during the past year. In 2 cases the method adopted was the combination of local excision with radium. The value of the radium treatment of recurrent and inoperable breast cancer becomes more apparent with the larger number of cases under review. Large masses shrink or disappear, ulcerations heal, and small nodules disappear, and the patient may enjoy good health for several years.

At the **MIDDLESEX HOSPITAL** the majority of cases of carcinoma of the breast were treated by the insertion of needles deep to the tumour and by surface application on a moulded columbia paste applicator or by means of the one gramme unit. In some cases the axillary glands were removed surgically, a transverse incision being

made dividing the pectoral muscles, which were subsequently resutured.

During the year under review a One Gramme Unit was lent to this hospital by the King Edward Fund. This is arranged as a fixed unit protected by lead which is 4 cm. thick at the back and sides of the unit, but tapers down to 1.5 cm. towards the outlet. The radium is arranged in 5 tubes of 200 mg., each placed around the circumference of a circle 5 cm. in diameter and at a distance of 5 cm. from the outlet. The effective radiation from the unit thus issues from a cylinder 5 cm. in diameter and 5 cm. long which produces a well-defined beam which can be projected in any required direction, as the lead radium carrier is mounted on a counter-weighted arm on a moveable carriage. The filtration is equivalent to 1 mm. platinum and 2.5 cm. of wood.

The ROYAL FREE HOSPITAL report states that:

The technique employed for the treatment of primary carcinoma of the breast has been the same as in previous years for the majority of cases. In a few cases, supplementary surface irradiation has been given immediately after the removal of the needles used interstitially.

During the year 14 cases were treated by radium only, all of which were inoperable. In 5, although the primary growth was advanced, the glands were not apparently involved; in 9, glands were palpable. Seven cases were treated by a combination of surgery and radium. In 3 of these, glands were not palpable, and in 4 cases the glands were already involved. Five were spheroidal-celled, and 2 were carcinoma simplex. Of these, 6 were treated by radical amputation with interstitial irradiation to the supra- and infra-clavicular regions and the intercostal spaces. One case had a local excision followed by interstitial irradiation (Keyne's technique). Seventeen cases of recurrences were treated. Of these, 10 were recurrences following surgery, 6 were recurrences after treatment by radium alone, and 1 after surgery and radium.

The report from St. BARTHOLOMEW'S HOSPITAL, referring to the secondary treatment of breast cancer, draws particular attention to the methods of examination subsequent to irradiation. It says that:

Suspicious swellings were noted during the periodical inspection of irradiated tumours in 7 cases. Excision of the suspected area was carried out, and in 5 there was active carcinoma, the remaining 2 showing only scar tissue. When following up carcinoma of the breast after irradiation, the difficulty of distinguishing between a surviving nodule of growth and a mass of scar tissue persists in spite of increasing experience; and we are driven to conclude that the solution of the difficulty lies in a systematic examination of a series of carcinomas excised at some definite period after irradiation. Plans for carrying out such an investigation are going forward.

The technique adopted by the SCOTTISH ASSOCIATIONS OF THE MEDICAL WOMEN'S FEDERATION remains unchanged. Eighteen patients were treated, 7 of which were new cases. All were treated by means of radon in platinum needles. All cases of cancer of the breast are being followed up, and the figures obtained are being placed at the disposal of Dr. E. K. Dawson, who is carrying out an investigation upon the histology and pathology of the breast, which it is anticipated will be of value in suggesting a relationship between the histological appearances of malignant growths and the ultimate prognosis.

## STATISTICAL DATA.

TABLE 2.

*Cancer of the Breast.*

	Year.	No. of cases treated.	Primary.		Recurrent.	
			Living.	Dead.	Living.	Dead.
Cardiff, Royal Infirmary .	1930	51	14	19	3	15
	1931	57	30	11	6	10
	1932	62	35	10	15	2
King's College Hospital .	1930	10	2	5	1	2
	1931	10	3	6	1	0
	1932	5	0	0	3	2
Marie Curie Hospital .	1926	4	0	1	1	2
	1927	1	0	0	1	0
	1928	5	0	1	1	3
	1929	16	3	6	2	5
	1930	23	7	6	5	5
	1931	33	11	7	8	7
	1932	45	15	4	25	1
Middlesex Hospital <sup>1</sup> .	1925	18	0	2	1	15
	1926	22	0	4	1	17
	1927	13	0	1	0	12
	1928	24	5	3	1	15
	1929	31	4	12	0	15
	1930	32	8	12	4	8
	1931	21	7	8	1	5
	1932	36	27	3	6	0
Royal Free Hospital .	1928	5	0	2	0	3
	1929	52	9	21	4	18
	1930	33	12	14	2	5
	1931	25	12	4	4	5
	1932	38	18	3	13	4
St. Bartholomew's Hospital	1925	6	1	5	..	..
	1926	6	0	6	..	..
	1927	13	6	7	..	..
	1928	40	13	27	..	..
	1929	53	29	24	..	..
	1930	36	23	13	..	..
	1931	31	27	4	..	..
University College Hospital	1921	1	..	..	0	1
	1923	1	..	..	0	1
	1925	2	0	1	0	1
	1926	1	0	1	0	0
	1927	2	0	0	0	2
	1928	3	0	1	0	2
	1929	9	0	3	0	6
	1930	21	2	3	4	12
	1931	9	3	1	3	2

<sup>1</sup> The statistical data from the Middlesex Hospital for the year under review have been received in the same form as that of Appendix I, published in the Special Report Series No. 174, 1931. It is the intention of the authorities of this hospital to continue this publication yearly from 1931 onwards.

Table 3 shows results collected from Table 2.

TABLE 3.

Year.	No. of cases treated.	Primary.		Recurrent.	
		Living.	Dead.	Living.	Dead.
1925	26	1	8	1	16
1926	33	0	12	2	19
1927	29	6	8	1	14
1928	77	18	34	2	23
1929	161	45	66	6	44
1930	206	68	72	19	47
1931	186	93	41	23	29

## B. CANCER OF THE UTERUS

### TECHNIQUE.

#### (1) Cervix Uteri.

ABERDEEN ROYAL INFIRMARY reports as follows on the treatment of cancer of the cervix uteri:

From a survey of the patients treated in 1930 and 1931, and surviving at the end of 1932, it would appear that the group treated by the Heyman technique (or a modification of it), followed by a course of deep X-ray therapy, shows a higher survival rate than that treated by radium alone. It is realized, however, that X-ray treatment is given only after the complete Heyman technique, and that in the group treated by radium only, a certain proportion have failed to complete the three-stage treatment.

The BIRMINGHAM GENERAL HOSPITAL report states that for the treatment of carcinoma of the cervix most centres in this country are following the techniques employed at Radiumhemmet, Stockholm, and the Institut du Radium in Paris. Treatment, however, is far from standardized and therefore an account of the routine adopted at this centre is appended.

#### Routine.

1. Leucocyte count is done for every patient before each application.
2. On the evening before operation the patient is given a Eusol douche 3ij to Oj.
3. The douche is repeated on the morning of operation and the cervix painted with hydrogen peroxide and benzine.
4. Under general anaesthesia radium is inserted, following either the Paris or the Stockholm technique.
5. The patient attends the Radium Clinic in one month's time for follow-up purposes, and is seen once a month for the first year and then once every three months, if the improvement is maintained.

The two methods of application (i.e. Paris and Stockholm) employed at this centre differ in some respects from those employed at Paris and Stockholm. The dosage of radium is identical, but certain changes in technical detail may be mentioned here:

In contradistinction to the routine at Stockholm a general

anaesthetic is given for each application (gas and oxygen usually), thereby permitting a thorough and more complete pelvic examination. The surgeon dictates a full description of the growth to the assistant in attendance.

The 'Paris' technique employed at this centre differs in several ways from that employed in Paris, viz.:

The preliminary dilatation of the cervix twenty-four hours before operation is not practised.

The 'Colpostat' is no longer employed, the vaginal application being carried in cylindrical 'Sorbo' corks, which are kept in position by ample gauze packing.

Deep X-ray therapy is not employed as a routine.

In the IRISH RADIUM CENTRE Report Dr. Chance (of the Richmond, Sir Patrick Dun's, Dr. Steevens' and Coombe Hospitals) states that the implantation method hitherto used in cases of carcinoma of the cervix uteri has been replaced by a surface technique. Enough time has not elapsed to compare the two, but so far there is little difference between the immediate results obtained by them.

Dr. Murphy, of St. Vincent's Hospital, Dublin, reports as follows on the technique employed in carcinoma of the uterine cervix:

The technique originally consisted of intra-uterine irradiation—2 tubes in tandem, screened by 2 mm. lead enclosed in a gum elastic catheter. This was left in position for from 7–8 days, the dosage varying from 2,400–3,000 millicurie-hours. Vaginally around the cervix tubes (lead) were placed in a hard paraffin wax, moulded accurately to fit the cervix and diseased area; later a central tube for uterine drainage, &c., was incorporated. During the last 2 years the wax mould has been discarded and needle implantation resorted to.

Four inoperable cases, in 2 of which the rectal wall was involved, died in the first year and 4 in the second. Seven remained free of symptoms for nearly 2 years, and since then 4 more are untraced. The remaining 3 are perfectly well at present.

At KING'S COLLEGE HOSPITAL, 18 cases of carcinoma of the cervix have been treated by the Stockholm method, 110 mg. of ra. el. being employed, the radium being applied for 22 hours, and the total screenage being equivalent to 3 mm. Pb. This treatment was repeated (unless circumstances were contra-indicative) on the 8th and 22nd day after the initial treatment, thus making 3 radium applications in all.

The MARIE CURIE HOSPITAL reports as follows:

With very few exceptions cases of cancer of the cervix have been treated by cavitary radium alone, but when facilities are available the standard technique will include supplementary external radiation. In the few cases which have received the combined treatment the X-radiation has generally been given about 10 days after the final radium dose.

Of the cases of cancer of the cervix treated during the year, 110 were squamous carcinomata and four adenocarcinoma. The diagnosis of all uterus cases was confirmed by microscopic examination. An attempt to classify the cases of squamous carcinoma of the cervix into definite types, as described by Martzloff, Broders, Ewing, and others, is complicated by having only small fragments from the surface, often degenerating, of the growth for study. Extensive curetting or the excision of tissue at the margin or into the depth of the surrounding healthy tissue is deprecated at this centre. The small fragments taken, though sufficient for a diagnosis of

malignancy, may not be representative of the general structures of the tumour. This does not mean, however, that the study of types in relation to radio-sensitivity may not prove to have considerable value. So far as this inquiry has gone at present, it has been possible to grade about 50 per cent. of the cases. In the first 200 investigated, 21 per cent. were of grade 1, differentiated type; 53 per cent. grade 2, transitional type; 9 per cent. grade 3, embryonic, undifferentiated type; and 17 per cent. grade 4, spindle-celled type.

The cases of adenocarcinoma of the cervix not only appear to respond to radio-therapy primarily in the same degree as squamous, but the later results also are apparently equal. Another young patient (aged 20) with adenocarcinoma of the cervix was treated in 1932 in addition to the one (aged 18) reported last year. Both are free from signs and symptoms of cancer, the first now in the third year.

The ROYAL FREE HOSPITAL reports as follows on the cases of carcinoma of the cervix uteri treated during the past year:

In 1932, 11 cases of epithelioma of the cervix uteri were treated, as previously reported, by a modification of the Stockholm technique. During the latter part of the year, supplementary treatment by deep X-ray therapy was given to the parametria—(by co-operation with another Hospital which has a deep X-ray therapy department). Of these 11 cases, 1 was Group I, 6 were Group II, and 4 were Group III (League of Nations' classification). Eight were squamous-celled carcinomata. Two were adenocarcinomata. One was reported as a 'vascular malignant growth with considerable areas of necrosis'.

The Report from ST. BARTHOLOMEW'S HOSPITAL states that the large diminution (their numbers now being only 12) in the number of cases of carcinoma of the cervix treated for the first time, is due to the fact that many of the cases now presenting themselves at this hospital are transferred to Mount Vernon Hospital. The report remarks upon the difficulty experienced in many cases of carrying out the routine of the Paris technique, and states that in cases in which the technique has failed, the old interstitial method has been carried out as before. Another matter of interest is that 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.

There is no change in technique to report from the SCOTTISH ASSOCIATIONS OF THE WOMEN'S MEDICAL FEDERATION. The following reactions and sequelae to treatment are noted.

The immediate reactions to treatment have continued to be very slight. Three patients had temperatures of over 100° F., but these were the two advanced cases in young women described earlier, and the one patient reported to have died of influenza. Early bladder symptoms have been slight and easily controlled by alkalis, and there have been no cases of early rectal reactions. One patient has developed a vesico-vaginal fistula and two developed ulcers in the rectum about a year after treatment. All three lesions have proved to be due to recurrence in grade III cases.

The difficulty of multiple anaesthetics has been largely overcome, as nearly all second and third treatments are now given without a general anaesthetic. In Glasgow scopolamine morphine is preferred, in Edinburgh nembutal gr. vj proves very satisfactory. Post-anaesthetic vomiting has been rather less troublesome, although it does occur. It has been the custom in the Edinburgh Hospital to use carbon dioxide to increase the respiratory exchanges at the end of ether anaesthesia for the last 3 years, but in spite of this the incidence of vomiting in these cases is high.

The Report from UNIVERSITY COLLEGE HOSPITAL says that no change has been made in the methods of radium treatment of carcinoma of the cervix uteri, which were fully described in last year's report. A few early cases have been treated this year by operation. A considerable development of the X-ray treatment of these cases is taking place, and efforts are being made to estimate the X-ray dosage as accurately as possible.

Slight modifications have, however, been made in the X-ray treatment. This year the amount of radiation reaching the growth was calculated in every case. The description of the graduated calipers used for obtaining the depth measurement and the drawing of the cross-section diagram was given in the Report of 1931. In some cases a three-field method, one anterior and two postero-lateral, was used. In the other cases a fourth vulvar field was added. The size of the fields varied with the extent of the disease, the usual area was 150 sq. cm. The anticathode skin distance was always 40 cm. The intensive split dose method was used, the whole treatment being spaced out over 16 days during the last 6 months. The dosage was increased from that given last year by 23 per cent.

## STATISTICAL DATA.

TABLE 4.

*Cancer of the Cervix Uteri.*

	Year.	Interval since irradiation. years	No. of cases treated.	Stage.							
				I.		II.		III.		IV.	
				L.	D.	L.	D.	L.	D.	L.	D.
Birmingham General Hospital	1929	3	41	3	9	1	15	0	3	1	9
	1930	2	17	5	4	1	2	1	2	0	2
	1931	1	49	13	4	3	11	3	9	2	4
	1932	..	37	9	0	10	0	7	5	2	4
King's College Hospital	1930	2	10	2	1	1	0	4	2	0	0
	1931	1	13	3	1	3	2	0	3	0	1
	1932	..	18	3	1	4	0	7	1	2	0
Marie Curie Hospital (3 mths.)	1925	7	14	0	0	2	1	2	6	0	3
	1926	6	59	2	0	2	5	8	34	0	8
	1927	5	57	1	0	6	3	9	19	0	19
	1928	4	85	8	0	9	8	19	27	4	10
	1929	3	110	4	0	13	4	27	42	2	18
	1930	2	136	6	0	27	5	35	46	3	14
	1931	1	126	7	2	17	2	48	30	7	13
	1932	..	114	7	0	32	1	53	8	10	3
Middlesex Hospital	1925	7	11	0	1	0	1	1	7	0	1
	1926	6	8	0	0	0	1	0	4	0	3
	1927	5	20	2	2	0	3	2	9	0	2
	1928	4	42	1	2	1	7	2	22	0	7
	1929	3	38	1	4	1	7	4	17	0	4
	1930	2	20	1	1	0	3	2	5	1	7
	1931	1	23	2	1	1	0	6	7	0	6
	1932	..	26	8	0	4	0	9	2	3	0
Royal Free Hospital	1929	3	3	0	0	1	1	0	1	0	0
	1930	2	8	1	0	4	0	1	2	0	0
	1931	1	3	2	0	1	0	0	0	0	0
	1932	..	11	1	0	6	0	4	0	0	0

TABLE 4 (cont.).  
Cancer of the Cervix Uteri (cont.).

	Year.	Interval since irradiation.	No. of cases treated.	Stage.							
				I.		II.		III.		IV.	
				L.	D.	L.	D.	L.	D.	L.	D.
St. Bartholomew's Hospital	1921	11	18	0	0	1	6	0	8	0	3
	1922	10	21	1	0	0	7	0	10	0	3
	1923	9	17	1	1	0	5	0	8	0	2
	1924	8	36	1	3	0	11	3	11	1	6
	1925	7	35	2	2	0	5	0	14	0	12
	1926	6	38	4	2	2	5	4	11	2	8
	1927	5	34	1	2	3	2	5	11	1	9
	1928	4	50	6	6	3	5	8	12	3	7
	1929	3	29	2	3	2	4	10	5	2	1
	1930	2	20	5	3	7	1	2	1	1	0
1931	1	11	2	1	3	3	2	0	0	0	
University College Hospital <sup>1</sup>	1921	11	23	2	2	1	6	0	12	0	0
	1922	10	10	1	3	0	2	0	3	0	1
	1923	9	26	1	3	0	7	0	10	0	5
	1924	8	22	2	1	2	9	0	5	0	3
	1925	7	22	2	3	2	6	0	5	0	4
	1926	6	12	0	0	0	4	0	4	0	4
	1927	5	19	1	1	2	5	1	6	0	3
	1928	4	33	2	5	4	9	1	9	1	2
	1929	3	25	5	1	6	5	3	1	1	3
	1930	2	17	4	0	2	3	1	7	0	0
1931	1	21	0	1	9	5	2	1	2	1	

<sup>1</sup> Includes cases treated by radium and operation.

Table 5 gives results collected from Table 4.

TABLE 5.

Year.	Interval since irradiation.	No. of cases treated.	Stage.							
			I.		II.		III.		IV.	
			L.	D.	L.	D.	L.	D.	L.	D.
1921	11	41	2	2	2	12	0	20	0	3
1922	10	31	2	3	0	9	0	13	0	4
1923	9	43	2	4	0	12	0	18	0	7
1924	8	58	3	4	2	20	3	16	1	9
1925	7	82	4	6	4	13	3	32	0	20
1926	6	117	6	2	4	15	12	53	2	23
1927	5	130	5	5	11	13	17	45	1	33
1928	4	210	17	13	17	29	30	70	8	26
1929	3	246	15	17	24	36	44	69	6	35
1930	2	228	24	9	42	14	46	65	5	23
1931	1	246	29	10	39	23	61	50	11	25

## (2) Corpus Uteri.

At the MARIE CURIE HOSPITAL it is reported that:

Sixty-eight cases of cancer of the body of the uterus have been treated by radium since October 1925, 19 being treated during the past year. With few exceptions these cases were inoperable, or operation was contra-indicated on general grounds. A total hysterectomy was performed on the cases which appeared to be clinically



operable. The technique described in the last Report has been continued. Supplementary X-radiation was given after the radium treatment in 13 of the cases treated during the year under review.

The data in Table 6 show the results of the treatment of cancer of the corpus between October 1925 and December 1932. (Total number treated 74. Suitable for classification 68):

TABLE 6.

Year.	No.	Operable.		Clinically inoperable.		Technically inoperable.		Living Dec. 1932.
		L.	D.	L.	D.	L.	D.	
1925 (3 mths.)	2	2	0	0	0	0	0	2
1926	1	0	0	0	0	0	1	0
1927	4	1	1	1	0	0	1	2
1928	5	2	0	0	1	0	2	2
1929	9	0	0	2	2	3	2	5
1930	11	0	0	2	3	2	4	4
1931	17	1	0	9	1	2	4	12
1932	19	0	0	12	0	7	0	19
Total	68							46

Table 7 shows the results of treatment of cancer of the corpus uteri at the MIDDLESEX HOSPITAL since 1925:

TABLE 7.

Year.	Number.	Alive years after treatment.					Alive Dec. 1932.
		1.	2.	3.	4.	5.	
1925	2	2	2	1	1	0	0
1928	2	2	2	2	2	2	2
1929	3	2	0	0	0	..	0
1930	2	1	1	0	..	..	0
1931	4	3	2	..	..	..	2
1932	3	3	..	..	..	..	3
Total	16						7

At the ROYAL FREE HOSPITAL 4 cases of adenocarcinoma of the corpus uteri were treated by a technique similar to that described in the Marie Curie Hospital report of last year, but varying in one respect, namely, that the short brass cylinders each contain 12.5 millicuries placed in each cornu; in the uterine cavity two or three tubes were inserted in tandem, containing in all 75 mg., filling the length of the body and cervix to the portio vaginalis; two vaginal applicators (Stockholm design) containing 25 mg. were placed one in each of the lateral fornices. Three applications of 22 hours are given in the periods of the Stockholm technique for the cervix uteri, the vaginal applicators being omitted at the third treatment. Supplementary deep X-ray treatment is given 2 to 3 weeks later.

C. CANCER OF THE MOUTH, NASOPHARYNX, LARYNX,  
AND OESOPHAGUS

Referring to the treatment of malignant growths in the nasopharynx the ABERDEEN ROYAL INFIRMARY Report states that the usual technique has been to draw the radium up into the *nasopharynx*, the amounts ranging from 50 to 135 mg., with a minimum screenage of 0.5 mm. of platinum, but preferably 1 mm. platinum, the time of exposure ranging from 18 to 84 hours.

They comment as follows upon 3 cases:

A case of advanced carcinoma of the nasopharynx (mentioned in the Medical Research Council Report for 1931) continues to do well 2 years after treatment. Histologically, this was a very 'cellular carcinoma'. Dose, 7,000 mgh. to primary growth. Another case, equally advanced as regards the primary growth, and with bilateral involvement of the related glands, is well and apparently free from malignant disease after six months: this was 'an anaplastic squamous epithelioma'. Dose to primary lesion, 4,000 mgh. A third case, even more advanced as regards extension both of primary and secondary growth, died after palliative treatment had been attempted. Dose to primary growth 11,000 mgh. The post-mortem examination revealed disappearance of the nasopharyngeal growth, with some degree of radium necrosis, but the growth had extended intracranially. Histologically the tumour was of 'a columnar-celled type'.

The Report from the GENERAL HOSPITAL, BIRMINGHAM, on the treatment of cancer of the mouth, states that the extent of the glandular involvement has proved the chief guide in rejecting cases as too advanced for treatment. The primary growth can nearly always be improved. Brawny diffuse infiltration of the neck with oedema of the skin and subcutaneous tissue renders the case quite unsuitable for any form of irradiation. Cases in which there is dense matting of large gland masses widely adherent to all the underlying structures do not respond to treatment and are usually rejected.

In the treatment of the primary lesions of the anterior two-thirds of the *tongue*, interstitial irradiation is carried out using a dose of from 8 to 12 mg. in 1 mg. needles left in position for from 8 to 12 days. The needles are well buried so that there is no need of alveolar protection. The optimum reaction phase is well marked. In treating the primary lesions of the posterior third of the tongue, the difficulty of accurate implantation of the needles and the suturing in position has been to a considerable extent overcome by placing the patient in the position used for dissecting out the tonsils, with the head hyper-extended. By doing this and using a skeleton gag and headlight, a very considerable degree of accuracy can be obtained. The dosage should be slightly heavier than in the anterior third, since the needles are rarely kept in position so long.

Cases of primary lesions of the *floor of the mouth* are very refractory. Interstitial irradiation is used, combined with surgical excision of parts of the alveolus later on, if this structure is involved. Glandular infection is early and often widespread. Cases of the *hard palate*, if the growth is early and superficial, are treated by surface irradiation from a dental applicator. Should the periosteum and bone be involved

diathermy excision is alone of value. The excision must be wide, the resultant gap being filled in by obturation. In the treatment of the *soft palate and fauces*, interstitial needling with short needles, using small cleft palate needles to suture the radium needles into position, gives the best results.

Glandular metastases are early and deep in the *neck*. In two cases needling from the neck by open exposure of the pharyngeal wall was used; the wound being reopened after ten days to remove the needles. Some sepsis followed but ultimately cleared and the results appear satisfactory. Cases of the *inner aspect of cheek and the lips* continue to give the best results owing to their marked sensitivity to radium. Cases of the *gland fields* have been treated on the lines laid down in last year's report. In cases where the glands have been inoperable, the method of exposing the area by reflecting skin flaps and needling under the eye has been followed by an occasional success. More use has, therefore, been made of this method, and a quantity amounting to 40–60 mg. of radium has been implanted in the neck for 8–10 days. The considerable sepsis and reaction that follows after the removal of the needles by reopening the wound takes a long while to clear up.

The methods of treatment employed at THE ROYAL FREE HOSPITAL for growths in the buccal cavity have already been described in a previous Report, and have been continued in the current year. The data in Table 8 give the results obtained in carcinoma of the buccal cavity, beginning with the year 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	..	2	2
1930	12	13	25	6	6	12	5	5	10	..	..	..
1931	7	6	13	4	2	6	..	..	..	..	..	..
1932	10	4	14	..	..	..	..	..	..	..	..	..

A = Without glandular involvement when first seen.  
B = With glandular involvement when first seen.

The Report from UNIVERSITY COLLEGE HOSPITAL refers to the classification of malignant growths in the regions under review, and the following is taken direct from it:

In our opinion a considerable number of the tumours of the nasopharynx, tonsil, pharynx, and posterior third of the tongue are of lymphatic origin. The nomenclature of tumours of this region is unfortunately not standardized, and the terms lymphosarcoma, endothelioma, transitional carcinoma, anaplastic carcinoma, and lymphoepithelioma have not the same significance for different observers. Owing to the divergent views of the pathology of these tumours we have classified them provisionally into two groups only, namely, carcinoma and malignant lymphatic tumours. This classification is based mainly on our personal opinion, and the group of lymphatic tumours probably includes cases which some would classify as carcinoma. Evidence is accumulating of the clinical behaviour, response

STATISTICAL DATA.

TABLE 9. Cancer of the Mouth, Nasopharynx, Larynx, and Oesophagus.

	Year.	Number of cases treated.	Tongue.		Floor of mouth.		Palate, tonsil, and fauces.		Lip.		Cheek.		Larynx.		Pharynx, nasopharynx and pharyngeal wall.		Oesophagus.	
			L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.
Birmingham . . . . .	1930	130	12	25	3	5	1	12	5	2	8	9	0	28	(larynx and pharynx)		0	22
	1931	134	12	20	5	6	5	10	16	8	8	6	1	9			0	28
	1932	111	10	11	12	3	13	5	3	3	7	2	5	7			2	19
Cardiff . . . . .	1930	64	0	16	4	5	..	..	2	6	1	5	0	4	1	6	0	14
	1931	75	7	9	1	2	..	..	5	7	1	1	0	4	6	14	1	17
	1932	96	18	4	4	0	3	5	18	0	1	1	5	5	3	4	12	13
King's College Hospital . . . . .	1930	27	3	7	..	..	0	3	0	2	2	0	0	1	1	5	0	3
	1931	26	1	1	..	..	1	3	..	..	0	2	0	3	2	6	2	5
	1932	38	11	1	..	..	6	0	0	1	2	0	1	2	1	1	6	6
Middlesex Hospital . . . . .	1925	37	1	8	0	1	0	5	1	2	0	4	0	4	0	3	0	8
	1926	38	0	6	0	4	0	3	1	2	0	2	0	7	0	4	0	9
	1927	57	2	15	1	3	0	5	2	3	0	4	0	6	0	4	0	12
	1928	78	1	27	2	3	2	10	6	1	1	4	0	7	0	1	0	13
	1929	101	4	23	4	11	1	4	8	8	0	2	1	6	0	3	0	26
	1930	98	3	22	7	10	0	7	8	4	4	2	2	12	0	2	0	15
	1931	86	7	13	3	10	3	9	9	1	1	2	5	4	0	1	1	17
	1932	83	22	4	5	0	9	3	11	0	2	1	4	4	0	1	5	12
University College Hospital (Columns marked * include lymphatic tumours).	1921	2	..	..	..	..	*	..	..	..	..	..	0	1	*	..	0	1
	1922	2	..	..	..	..	0	1	..	..	..	..	..	..	0	1	..	..
	1923	3	..	..	0	1	0	2	..	..	..	..	..	..	0	3	0	4
	1924	7	..	..	..	..	..	..	..	..	..	..	..	..	0	1	0	1
	1925	5	0	1	..	..	0	2	..	..	..	..	..	..	0	1	0	..
	1926	2	..	..	..	..	0	1	..	..	..	..	..	..	..	..	..	..
	1927	1	0	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	1928	15	0	5	0	1	0	5	..	..	0	1	..	..	0	2	0	1
	1929	27	3	5	0	1	1	6	0	2	..	..	0	2	1	3	0	3
	1930	38	0	12	1	2	1	3	4	2	..	..	..	..	3	7	0	3
	1931	26	5	3	3	1	2	1	1	1	1	2	0	1	0	3	0	2

to irradiation and histological appearance of these tumours, from which we hope a more satisfactory classification may be evolved. In a series of cases of primary tumours of lymphatic glands (not all from the neck) histological appearances similar to those of the pharyngeal tumours have been found, suggesting strongly a lymphatic origin for the latter.

*Methods of Treatment.* In the majority of cases of carcinoma, the primary growth is treated by interstitial irradiation. Early cases of carcinoma of the pharynx are treated by radical operation. The treatment of the glands varies with the site and nature of the primary growth and the degree of involvement, of which three stages are recognized: (1) no glands palpable; (2) glands enlarged, but operable; (4) inoperable glands. The methods in use are described in the 1931 Report. During 1932 these methods have been supplemented by the One Gramme Unit, lent by the King Edward's Hospital Fund, which will to some extent replace other methods.

The malignant lymphatic tumours are characterized by radio-sensitivity and are mostly treated by X-rays or the One Gramme Unit.

Table 10 shows results collected from Table 9.

TABLE 10.

	No. of cases treated.	Tongue.		Floor of mouth.		Palate, tonsil, and fauces.		Lip.		Cheek.		Larynx.		Pharynx, nasopharynx and pharyngeal wall.		Oesophagus.	
		L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.
1925	42	1	9	0	1	0	7	1	2	0	4	0	4	0	4	0	9
1926	40	0	6	0	4	0	4	1	2	0	2	0	8	0	4	0	9
1927	58	2	16	1	3	0	6	2	3	0	4	0	6	0	4	0	12
1928	93	1	32	2	4	2	15	6	1	1	5	0	7	0	3	0	14
1929	128	7	28	4	12	2	10	8	10	0	2	1	8	1	6	0	29
1930	331	18	82	16	22	2	26	19	16	16	16	2	17	5	20	0	57
1931	337	32	46	12	19	11	23	31	17	11	13	6	12	8	24	4	60

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

ABERDEEN ROYAL INFIRMARY reports as follows on the treatment of cases in this section:

One patient with carcinoma of the rectum treated in 1930 is dead, and of 7 patients with carcinoma of the rectum treated in 1931, only two were alive at the end of 1932. Of these 2, 1 was treated according to the Newmann and Corynn technique. All the others were treated by insertion of radon seeds *per rectum*; every case was inoperable at the time of the first treatment. Some palliation has been afforded in several instances, as estimated by relief of pain and by the cessation or diminution in the discharge of blood and mucus *per rectum*.

One patient with very advanced squamous carcinoma of the anus, showing infiltration of the recto-vaginal septum and of the glands, shows, at present, complete absence of any sign of growth following interstitial irradiation; colostomy has been avoided. This case is, however, of only five months' standing.

The Report from the GENERAL HOSPITAL, BIRMINGHAM, states that out of 13 cases of malignant growth of the bladder, 3 have been treated by inserting in the bladder a 'Sorbo' rubber ball with a concentrated dose of about 25 mg. of radium at the centre. The report says:

One of these cases is worth special mention. The patient was admitted to Hospital in 1931 with a history of painful micturition and haematuria. He had had a papilloma of the bladder removed five years previously and had remained well up to 7 weeks before entering Hospital. Haematuria recurred accompanied

by much pain and frequency of micturition. In the intervals between the haematuria the urine was normal. He had previously had a gastro-jejunostomy for ulcer, but there was no history of bladder trouble prior to the removal of the papilloma 5 years before admission.

On examination there was 20 oz. of residual urine, and an enlarged prostate was palpable per rectum. On cystoscopy the base of the bladder was covered all over with papillomata extending round to the sides though rather more sparsely. An attempt was made to treat them by diathermy, but they were too numerous. A supra-pubic cystotomy was therefore performed and the presence of the papillomata confirmed. One of the larger growths was removed for microscopical examination and a Sorbo ball, about the size of a golf ball and containing radium was inserted into the bladder and fixed by stitches. The ball was removed on the tenth day and the bladder allowed to heal. It was 6 weeks before the patient was discharged. During the last year up to the date of this report, the patient has been in perfect health.

The results of treatment are shown in Table 11.

TABLE 11.

	1930.	1931.	1932.
Clinical cures . . . .	2	3	2
Improved . . . . .	1	..	..
Not improved . . . .	2	1	1
Not traced . . . . .	..	1	..
Dead . . . . .	8	3	2
	13	8	5

The Report from CARDIFF ROYAL INFIRMARY says:

Of the 20 cases of carcinoma of the rectum, 3 were operable, 1 borderline, and 16 inoperable. Of the 16 inoperable cases, 7 received radium (3 by the interstitial method and 4 by the cavitary method). The 2 living cases treated with radium are worth recording. One had a large ulcerating mass situated 2 inches from the anus. Obstruction was complete, and a colostomy had been performed 3 months previously at another hospital. Ten radium needles of 2 mg. element each distributed over an active length of 32.2 mm. and screened by 0.5 mm. platinum were inserted into one growth for 241 hours giving a total of 4,352 mg. el. hrs. A similar treatment followed a month later when 8 needles of 1 mg. radium element distributed over an active length of 16.2 mm. were inserted for 151 hours. In December 1932 this patient was free of symptoms. There was no discharge, and rectal examination revealed no other evidence than a fibrous scar. The general health was excellent.

The other had a rectal growth which was manifest by two hard nodules just inside the anal orifice; one situated postero-lateral on the left side and the other postero-lateral on the right side of the anal orifice. Radium was inserted interstitially and 6 needles of 2 mg. element each distributed over an active length of 32.2 mm., together with 4 needles of 1 mg. each distributed over an active length of 16.2 mm., remained *in situ* for 144 hours, giving a total dose of 2,304 mg. el. hrs. This patient is now free of any symptoms and rectal examination reveals no evidence of growth.

Both cases were clinically rectal carcinoma.

At the MARIE CURIE HOSPITAL 7 cases have been treated by radium alone during the year. Only 1 had preliminary colostomy. In 1 patient, aged 73 years, acute bladder symptoms developed a fortnight after leaving the Hospital, and the patient died on the second day of the attack from urinary failure. This is the only case of severe cystitis that has occurred out of a total of 28 cases treated; a fact of

interest in view of the frequent occurrence of bladder complications following operations for rectal cancer.

The following table shows the results of treatment since 1928:

TABLE 12.

Year.	No.	Primary growth.				Recurrence.		Living Dec. 1932.
		Operable.		Inoperable.		L.	D.	
		L.	D.	L.	D.			
1928	4	1	0	0	2	0	1	1
1929	2	0	0	0	2	0	0	0
1930	11	1	0	3	6	0	1	4
1931	4	1	0	1	0	1	1	3
1932	7	2	1	4	0	0	0	6
Total	28	5	1	8	10	1	3	14

At St. BARTHOLOMEW'S HOSPITAL only 4 cases of carcinoma of the rectum were treated during the year under review. In only 1 case was radium applied to a growth of the rectum—a man aged 73 with an operable growth who after colostomy refused excision. In the remaining 3 cases radon was applied to the lymphatic glands transperitoneally at the time of colostomy, with a view to subsequent excision. In 1 of these the glandular spread was found to be so extensive that the projected excision was abandoned, although the growth was quite operable.

The following table shows the results of treatment since 1925:

TABLE 13.

Date.	Total cases.	Clinical cures.	Improved.	Cures not expected.	Untraced.	Died.
1925	4	..	..	..	..	4
1926	6	1 <sup>a</sup>	..	..	..	5 <sup>b</sup>
1927	7	..	..	..	..	7
1928	13	4 <sup>c</sup>	..	..	..	9
1929	28	2 <sup>d</sup>	..	1	..	25
1930	14	4 <sup>e</sup>	..	1	..	9
1931	12	4 <sup>f</sup>	..	..	1	7
1932	4	..	..	3	..	1
	88	15	..	5	1	67

<sup>a</sup> One inoperable case improved by ra. later excised.

<sup>b</sup> One case died of metastasis liver 5 years after treatment without apparent rectal recurrence.

<sup>c</sup> One case radium to glands only as preliminary to excision.

<sup>d</sup> One inoperable case rendered operable by ra. and later excised.

<sup>e</sup> One case radon to glands only as preliminary to excision.

<sup>f</sup> All excised after radon to lymphatics.

Summary of cases surviving (April 1933) treated during 1925-31.

Total cases 84. Survivors 17. (Clinical cures 15.)

1926. No. 10. Inoperable. Rendered operable. Excised. *Apparent cure.*

1928. No. 18. Inoperable. *Apparent cure* (over 5 years). (Without colostomy.) Intra-peritoneal radiation.

1928. No. 21. Radium to gland only. Excision. *Apparent cure.*

1928. No. 22. Operable growth (*aet.* 70). Refused colostomy and excision. *Apparent cure* (5 years).
1928. No. 27. Advanced inoperable (*aet.* 37). Appeared hopeless. *Apparent cure* (4½ years).
1929. No. 34. Inoperable. Rendered operable. Exploration for radical cure. Suspected secondary deposit found in liver. Subsequent history suggests diagnostic error as regards liver.
1929. No. 48. Inoperable. Rendered operable. Excised. *Apparent cure* (4 years).
1929. No. 51. Inoperable. *Apparent cure* (4 years).
1930. No. 58. Epithelioma of anus. *Apparent cure.* (No colostomy.)
1930. No. 60. Comfortable, but not cured.
1930. No. 62. A woman (*aet.* 81) with advanced growth. *Apparent cure* (3½ years).
1930. No. 68. *Apparent cure* following intra-abdominal radon and posterior barrage with radium.
1930. No. 70. Radon to glands only. *Apparent cure* following excision.
1931. No. 72. Lymphatic barrage—excision.
1931. No. 74.       "       "       "
1931. No. 77.       "       "       "
1931. No. 78.       "       "       "

The views fully expressed in the 1931 report as to the indications for radium treatment have not been altered.

## STATISTICAL DATA.

TABLE 14. *Cancer of the Rectum.*

	1925.		1926.		1927.		1928.		1929.		1930.		1931.		1932.	
	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.	L.	D.
Birmingham . . .	..	..	..	..	..	..	..	..	..	..	5	8	4	3	3	2
Cardiff . . . . .	..	..	..	..	..	..	..	..	..	..	1	28	17	13	15	5
Marie Curie Hospital . . .	..	..	..	..	..	..	1	3	0	2	4	7	3	1	6	1
Middlesex Hospital . . .	0	5	1	0	1	4	0	14	1	4	3	3	1	1	3	1
St. Bartholomew's Hospital . . . . .	0	4	1	5	0	7	4	9	3	25	5	9	4	7	3	1
University College Hospital . . . . .	..	..	0	1	..	..	..	..	0	2	0	6	..	..	..	..

Table 15 gives the results collected from Table 14.

TABLE 15.

Year.	Number of cases.	Report at end of 1932.	
		Living.	Dead.
1925	9	0	9
1926	8	2	6
1927	12	1	11
1928	31	5	26
1929	37	4	33
1930	79	18	61
1931	54	29	25
1932	40	30	10



## E. CANCER OF THE BRAIN

A combined interim report from the ROYAL INFIRMARY, MANCHESTER, and THE HOLT RADIUM INSTITUTE, states that in the treatment of brain tumours two radiation methods of treatment are being investigated:

1. *Implantation of gold radon seeds.* One of the serious drawbacks of radon implantation in brain tumour cases is the difficulty of estimating before operation whether implantation is practicable or not and the extent of the growth. It was decided that the radium therapist should stand by at every brain-tumour operation with sufficient seeds for all ordinary purposes and should be prepared to calculate a dose and implant seeds if found advisable. It was realized that this would entail numerous occasions in which the seeds would not be used and would be wasted, but on the other hand it saved the alternative and inadvisable procedure of having to open the skull a second time. It was decided where this method was employed to carry dosage to the maximum intensity tolerated by normal brain tissue, increasing dosage gradually until this point was reached.

2. *Deep X-ray therapy.* The only alternative to radon-seed implantation is external irradiation. After discussion it was decided that it was more practicable to deliver massive doses of irradiation from outside by means of X-ray than by means of any form of radium pack. External methods of radium irradiation were therefore discarded in favour of intensive deep therapy. Apart from the amount of radiation given, the technique was kept constant over the year. It was believed that brain tissue would tolerate a greater intensity of irradiation than could be tolerated by the skin, and a technique was devised to give a greater dose in the depth than at the surface. Five fields were used, frontal, occipital, vertical, and two temporal. These fields did not overlap. In all cases the treatment was spread over 21 days, each skin area being treated every day or second day. The actual dosage used per case was gradually increased as the skin tolerance was appreciated.

Although it is impossible to give any indication as to the ultimate results of this procedure, the following points have emerged:

1. Irradiation produces immediate results in a percentage of cases by either method, and this immediate result is greater than is to be expected purely as the result of the decompression. In several cases the hernia which was present after operation diminished either to normal or actually receded to below the line of the normal contour.

2. The brain tissue has an immediate tolerance, of a very high degree, to irradiation. Whether this tolerance will be permanent, or whether late necroses will result cannot yet be stated, but the present indications are that the toleration is real and permanent and at least twice the tolerance of normal skin.

3. Because of this toleration it is possible to deliver by means of external radiation doses considerably in excess of the incident dose

on the scalp. This, as indicated, is achieved by the use of multiple portals of entry.

4. The observation was made that the toleration of the skin of the scalp is about 50 per cent. greater than skin tolerance in other regions of the body.

Table 16 shows the results of radium treatment of cerebral tumours at KING'S COLLEGE HOSPITAL since 1930:

TABLE 16.

<i>New cases of cerebral tumour treated in</i>		<i>Alive Dec. 1930.</i>	<i>Alive Dec. 1931.</i>	<i>Alive Dec. 1932.</i>
1930 . . . . .	3	2	1	1
1931 . . . . .	3	..	1	1
1932 . . . . .	1	..	..	0

## F. EXPERIMENTAL SECTION

This section is divided into two parts, (1) and (2), grouping researches of a physical and of a biological character.

### (1) Physical.

The report from the STRANGWAYS LABORATORY states that a new unit of intensity has recently been adopted in experimental work which may be defined as 'the intensity due to a point-source of 1 mg. of radium acting at a distance of 1 cm. and filtered by 0.5 mm. platinum'. Dosage has been calculated on this basis. If the minimum dose which will produce any visible effect upon mitosis is taken as unity, then a delayed lethal effect (death within three weeks) is produced by 340, interference with carbohydrate metabolism by 1,100, and death of the culture as a whole is produced by 2,800 units.

It is well known that the physical intensity of radiation varies from point to point in the neighbourhood of radium needles. Miss Cox has been investigating the biological efficiency of radiation from such sources by determining the diminution of cell division. The biological effect of irradiation is also found to vary within very wide limits. It would appear that mitosis may be below normal in a direction at right angles to the length of the needle and at the same time be above normal (compensatory increase following initial diminution) in the direction of the length of the needle.

The Report from MR. W. V. MAYNEORD, of the Cancer Hospital, is mainly concerned with physical measurements applicable to radiological work. The two main problems attacked have been: (a) the absolute measurement of the radiations in a standard unit, preferably the  $r$  unit as used in X-ray therapy, and (b) the question of the distribution of radiation around relatively simple sources of radiation.

The first problem has been attacked along several lines. Experiments have been made with ionization chambers of simple design

whose walls have an effective atomic number approximately that of air. There is, therefore, some theoretical justification for the assumption that the ionization observed in them is approximately equal to that which would be observed in an equal volume of unenclosed air. In this way one obtains an estimate of the ionization to be observed at a given distance for a given amount of radium in absolute units. The previous estimate by this author (1) that 1 mg. hr. at 1 cm. distance from a point-source is approximately 9 r has been confirmed, though the previous experiments were carried out under very different conditions. Experiment shows, moreover, that the ionization observed in a very thin walled chamber (0.002 mm. cellophane) is for gamma-rays largely determined by recoil electrons produced at some distance from the chamber, and that to obtain definite results an optimum wall thickness should be employed which is (a) thick enough to stop these recoil electrons before entering the chamber, and (b) thin enough to avoid appreciable absorption. The experiments so far performed are largely preliminary, and are being supplemented by measurements using a parallel plate chamber of the type now used in X-ray standardization.

Work has also been carried out on the measurement of gamma-rays with a small condenser dosimeter similar to that developed by Sievert. It appears particularly suitable for some types of percentage depth dose measurement in water when very large radiation intensities are not available.

In reference to the second problem of distribution, an attempt has been made to test experimentally some of the simpler conclusions arrived at mathematically in earlier work (2) (3). It was then shown that a theory of plane-surface radium applicators could be developed. This implied, for instance, that at a certain distance from a ring source of radioactive material a flat field of irradiation could be obtained. Experiments were therefore made in which the radium needles were placed in rings of various sizes and photographic films were exposed parallel to the plane of the radioactive ring. On measuring the blackening of the films with a simple photoelectric photometer it was found that theory and experiment were in approximate agreement. Moreover, an experimental investigation of the distance from the plane of the ring at which a uniform field of irradiation was obtained, also confirmed approximately the theory, though some divergence was observed when the ring of radioactive material was not complete. This again could be accounted for mathematically. The theoretical distribution of gamma-rays around two 'point' sources was also confirmed.

DR. P. R. PEACOCK, in a report from the Glasgow Royal Cancer Hospital, states that his radium investigations have centred round the following subjects: The ultra-violet fluorescence of calcium tungstate and sodium bromide have been recorded by prolonged exposures to gamma-rays, but all attempts to obtain satisfactory spectra from solutions have failed. The visible fluorescence of pure water described

by Mallet has been observed, and a very faint spectroscopic record of this has been obtained by using, approximately, 0.25 g. radium to excite the fluorescence.

## (2) Biological.

The interim report by DR. MURIEL ROBERTSON, of the Lister Institute, on the irradiation of *Bodo caudatus* shows that the investigation has been carried a further stage, the following being the salient facts.

*Serum Reactions.* The radium-modified cultures showed a different reaction on exposure to an immune serum made against the normal *Bodos* in the blood of rabbits. Once the change is sufficiently well impressed it is retained for a very large number of generations. Moreover, if a single *Bodo* is taken from a heavily irradiated culture and placed in a known bacterial association it retains the character of the parent strain in these respects. The change in behaviour in the irradiated strain was shown (it may be recalled) in the serum test by secondary clumping of great intensity taking place in the survival plates of *Bodos*, taken from the serum titration plates, and put to grow in culture media. This phase was represented in the normal strains by a transitory stickiness of varying degree.

It will be recalled that primary clumping occurs in all *Bodos* when placed directly into concentrations of immune serum. It appears that all clumping of *Bodo* (*but not lysis*) depends upon the presence of salts, and if the immune sera are diluted with distilled water and if the titre permits of a sufficient dilution of the serum salts, death occurs without clumping. In secondary clumping this proves also to be the case, and the distinction between the two sets (the normal and the irradiated) seems to be that the low concentration of salts in the culture medium is not sufficient to produce more than a transitory effect in the normal, while it clumps the irradiated. The direct deduction from this would appear to be that the amount of serum which adheres to the body of the *Bodos* is greater in irradiated strains than in normal ones. Secondary clumping can be greatly reduced in irradiated strains by reducing the salt content of the medium. Of single salts calcium is the best clumper.

In heavily irradiated strains, even after having been removed from the radium for some time (several months), there is, in balanced titrations, a quite definitely greater sensitiveness to the lytic effect of immune sera than in the normal. Two curious things have arisen, namely, differences in the action of different batches of sera in regard to secondary clumping, some being much more active than others, and secondly, differences in the production of the heritable radium change from normal strains.

All the matters in this section are under investigation, and it will be appreciated that as all the work, to have any value, must be done from stabilized and counted transfer cultures, the progress must necessarily be rather slow.

*Changes in Appearance.* The heritable radium effect in effectively irradiated strains shows itself also in the behaviour and appearance

of the culture. These changes are also carried into the isolated single *Bodo* cultures. Efficiently irradiated strains show an exaggeration of the phenomenon of 'Thigmotaxis', which in *Bodo* is shown by the formation of free delicate circles and rosettes and balls in which the individuals are lightly caught by the tip of the longer or trailing flagellum. These cultures also show premature encystation.

If growth curves are made by starting five or six identical plates of each of two stabilized strains (one normal and one radium-modified) and counting pairs at intervals, it is found that the shape of the two curves show consistent differences. Moreover, the influence of different media upon the curves can be studied and the incidence of encystation and other data can be obtained by making preparations (for fixing and staining) of the *Bodos* at the time of the count. This permits of the use of the data of mean length, coefficient of variation, and numbers of cysts per thousand. At the moment it seems that irradiated strains are more sensitive to growth products than normal.

The report from the STRANGWAYS LABORATORY states that material for the cultivation of human carcinoma has been obtained from 11 cases of carcinoma of the cervix and 2 cases of malignant growth of the body of the uterus. In five of these specimens fibroblasts only appeared in the cultures, a mixed growth of fibroblasts and epithelial cells was obtained from four specimens, while four specimens gave no result. Some of the material was subcultivated three times and showed outwandering and mitosis after 17 days' growth *in vitro*. Growth is much slower than in the case of material from human embryos, and it was found best to subcultivate every 7th or 8th day. The most satisfactory of the culture media tried so far is a mixture of fowl plasma (1 part) and concentrated chick extract (1½ parts). The growth obtained has not yet been sufficiently uniform in a whole series of cultures to test the radio-sensitivity of the cells.

DR. PEACOCK reports upon an investigation into the influence of beta- and gamma-rays on lymphoid tissue and circulating lymphocytes. A wide range of doses of gamma-rays has been applied to the lymphoid tissues of experimental animals and, particularly, to the rabbit's appendix, and the local reactions have been observed over periods varying from a few days to several months.

The well-known radio-sensitivity of lymphoid tissue has been observed, and the varying degrees of damage to the epithelial and connective tissues receiving the same dosage as the lymphoid tissue have been studied.

A report from DR. J. C. MOTTRAM, of the Radium Institute and Mount Vernon Hospital, contains an account of experimental work by himself and his collaborators.

Miss Goulston, having perfected the technique of exposing the allantoic membrane of the chick embryo, investigated the action of beta radiation upon it. Both degenerative and hypertrophic reactions were observed, as well as changes in the blood-vessels. The

hypertrophic reactions were considered to be secondary reactions to injury and of the nature of repair (4). Miss Goulston also investigated the action of exposure to radium on the fragility of the red cells (5), and found an increase of fragility after large doses of beta radiation; only slight haemolysis was obtained with 119 hours' gamma-radiation from 120 mg. of radium.

Dr. Mottram reports an investigation, in collaboration with Dr. Eidinow, upon divided dosage in radium therapy (6), in which it was found that Jensen's rat sarcoma was as sensitive to divided dosage as to a single dose, within the experimental limits, whereas the skin, as is well known, reacts more to the single dose. The same authors investigated the skin reactions and the reaction of Jensen's rat sarcoma to radium under conditions of diminished blood-supply (7), and came to the conclusion that in both cases a smaller reaction occurs than with normal conditions operating. The action of radium on the blood-supply of tumours was also investigated by inoculating the animals with Indian ink and finding that a few days after radiation the circulation was interfered with, so that whereas control tumours in the same animal became black, the radiated tumours remained white (8).

The relationship between beta- and gamma-radiation in the treatment of tumours was the subject of research. As observed by others with X-rays, it was found that previous exposure of tumour cells to beta- or gamma-rays, rendered them less sensitive to these radiations; on the other hand, cells thus made insensitive to gamma-radiation were found to be not less sensitive to beta-radiation than normal cells; and the same with beta-sensitized cells towards gamma-radiation (9).

Attempts were made to produce a tumour by subjecting normal cells *in vitro* to irradiation and then inoculating them into animals (10). Out of a large number of experiments, one tumour resulted from cells which had had a sub-lethal dose of beta-radiation. The tissue used in this case was the normal testis of the rat. The following account is taken from the published paper to which reference is made in the list of references at the end of this section (11):

The testes of a male rat, 13 days old, were taken; they were minced with knives; half the emulsion was exposed for 15 minutes to radiation (applicator of 60 mg. radium element, area 4 sq. cm. screen 0.12 mm. silver); about 3 cm. of the radiated emulsion was inoculated into the right thigh muscles and the right flank of a sister of the castrated rat, non-irradiated emulsion into the left thigh and flank; 72 days afterwards the animal was killed. No tumour was felt ante mortem, but post mortem two nodules joined together, each measuring  $10 \times 5 \times 5$  mm., were found embracing the upper end of the right femur. The tumour was dissected away from the surrounding normal tissues with little difficulty; it presented on section a smooth white surface and was of the consistency of firm jelly; there were no necrotic areas. Histologically the tumour was surrounded by a narrow layer of fibrillar connective tissue separating it from the normal tissues, such as muscle and adipose tissue, which were not invaded, only displaced. This connective tissue was in many places densely infiltrated with lymphocytes and plasma-cells, and occasionally these cells were present also in the superficial layers of the tumour. For the most part the tumour consisted of healthy cells presenting numerous mitoses; areas of early degeneration were also present where there was vacuolation of the cytoplasm and pyknosis, and loss of structure of the nuclei. Choosing a place where

mitotic figures were numerous, the tissue was found to be composed of cells of almost entirely one kind apart from an occasional lymphocyte. These cells had a finely fibrillar or granular cytoplasm, which presented some vacuolation; cell margins were difficult to define, and the tissue had the appearance of a syncytium; the nuclei were large and oval, measuring often  $1/60 \times 1/120$  mm.; they stained palely, were firmly granular, and contained one or more small nucleoli. These cells are shown in Fig. 1 (A). Sometimes, as in Fig. 1 (B), the nuclei were spindle-shaped and lay in bundles, many pointing in the same direction.

In several parts of the tumour remains of seminiferous tubules were seen, consisting externally of flattened connective-tissue cells, and several layers of spherical cells bounding a central cavity; the round cells were not dividing and there was no evidence of spermatogenesis. In some cases the tubules consisted of only flattened

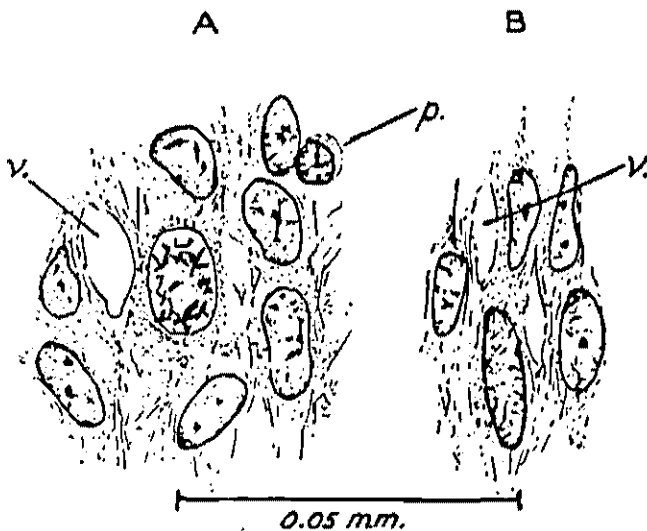


FIG. 1.

*p.*, lymphocyte; *v.*, vacuole in cytoplasm.

connective-tissue cells enclosing a cavity containing cell-debris; in other cases the flattened connective-tissue cells were absent and the spermatogonia had spread among the tumour-cells for a short distance. Sometimes the central cavity was absent, and the spermatogonia formed a solid cell mass (as shown in Fig. 2). Only two mitoses of the spermatogonia cells were seen.

The conclusion is that the tumour is a sarcoma; and from the fact that it occurred at the site of inoculation, and contained remains of seminiferous tubules, it is inferred that it was derived from the inoculated material. The tumour grew like an inoculated tumour, pushing the normal tissues aside, was easily separated by dissection, and did not infiltrate; nevertheless, the possibility that it was derived from connective-tissue cells of the inoculated rat cannot be entirely ruled out. Small pieces of the tumour were placed in both flanks of 24 rats, with negative results.

The main results of an investigation reported by Prof. Russ and Miss Scott, of the Barnato Joel Laboratories, Middlesex Hospital, in the response of animal tumours to lethal and sub-lethal doses of X-rays (12), are that even when every available precaution is taken to eliminate experimental variables, important variations in the response of these tumours occur when they are given specified doses of X-rays. The variations in the normal behaviour of this particular strain of tumour, Sarcoma F. 16 of the Imperial Cancer Research Fund, were

studied over a period of eleven years. The present rate of growth of the tumour is more than five times its initial speed, and sections show many more actively growing cells. These changes are illustrated in Figs. 3, 4, and 5. In Fig. 3 the graphs are shown illustrating the rate of growth of this tumour in 1921 and 1932. Fig. 4 is a micro-photograph of a section of this tumour at the earlier date. Fig. 5 shows its present features.

The increase in the rate of growth is probably due to the methods of technique used by the authors in its propagation, and to some extent to the fact that rats of a pure breed, very susceptible to sarcoma, have been used throughout the experiments. Another part of

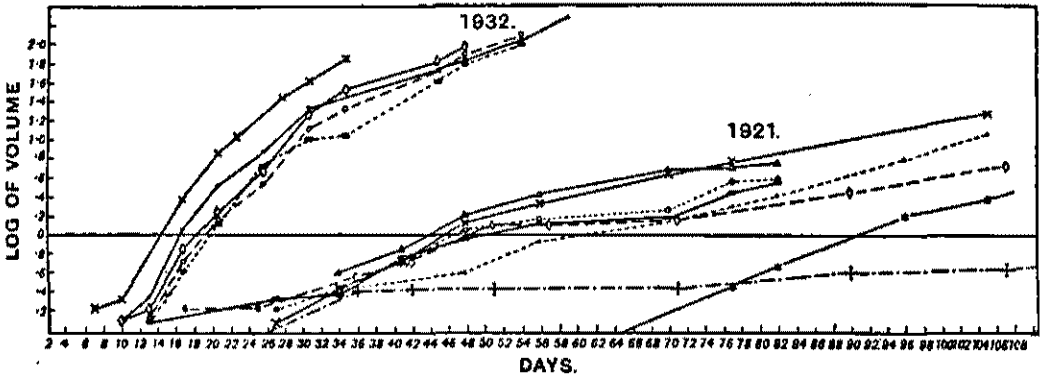


FIG. 3.

the investigation was a determination of the most efficient way of delivering the dose of X-rays. The effect of a certain exposure was increased if the total dose was divided and given on three successive days, but if the interval between the doses was much longer (i.e. in some cases as long as 6 days) the effect of the total does was not nearly as great as if it had been given in one exposure. These effects are considered by the authors to be largely bound up with the actual rate of growth of the tumour, for it was generally found that a dose of X-rays was more effective in controlling the growth of a slowly-growing than a rapidly-growing tumour and that the quicker the rate of growth of the tumour the shorter the time in which the total dose of irradiation should be given. The trend of modern radiation-therapy is to exploit the divided dose technique, and it remains to be seen what is the best relationship to maintain between the intervals of irradiation, the whole period of irradiation, the radio-sensitiveness of the tumours, and their normal rapidity of growth.



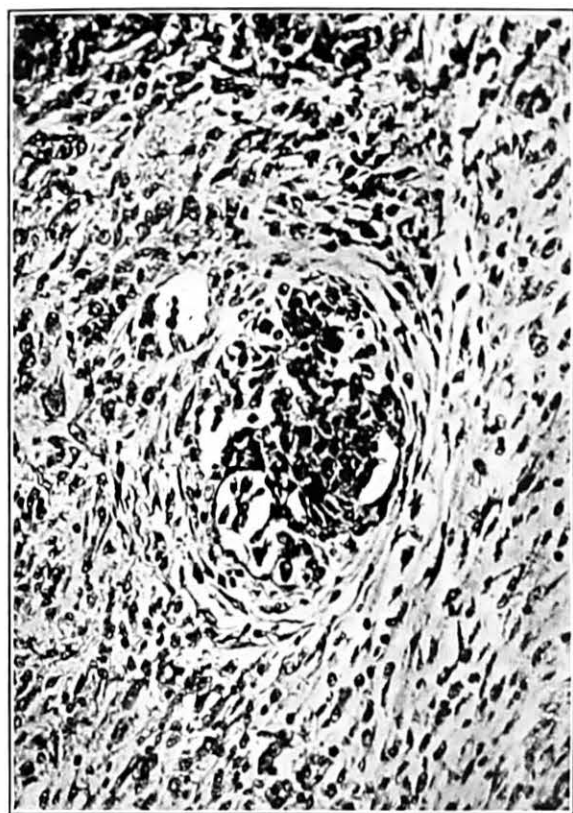


FIG. 2.

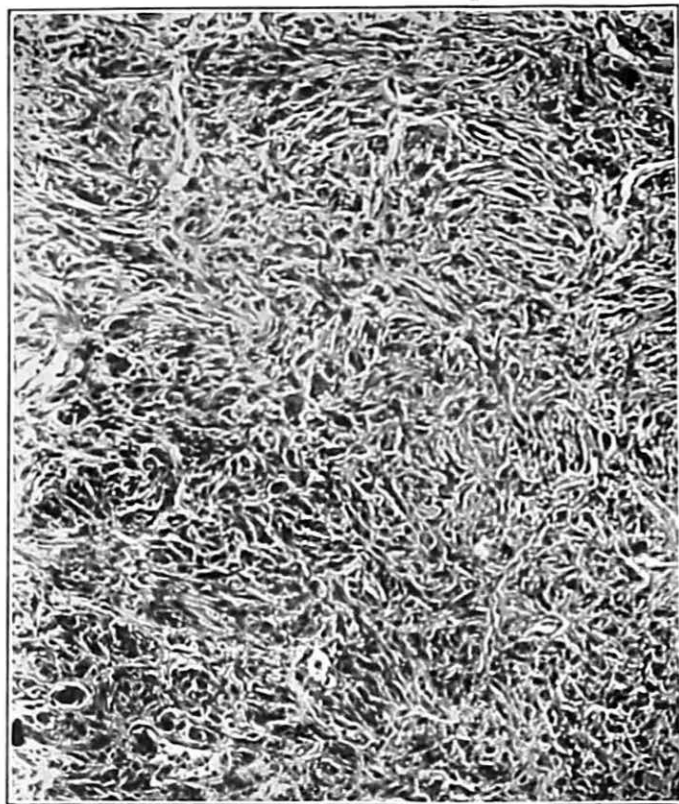


FIG. 4.

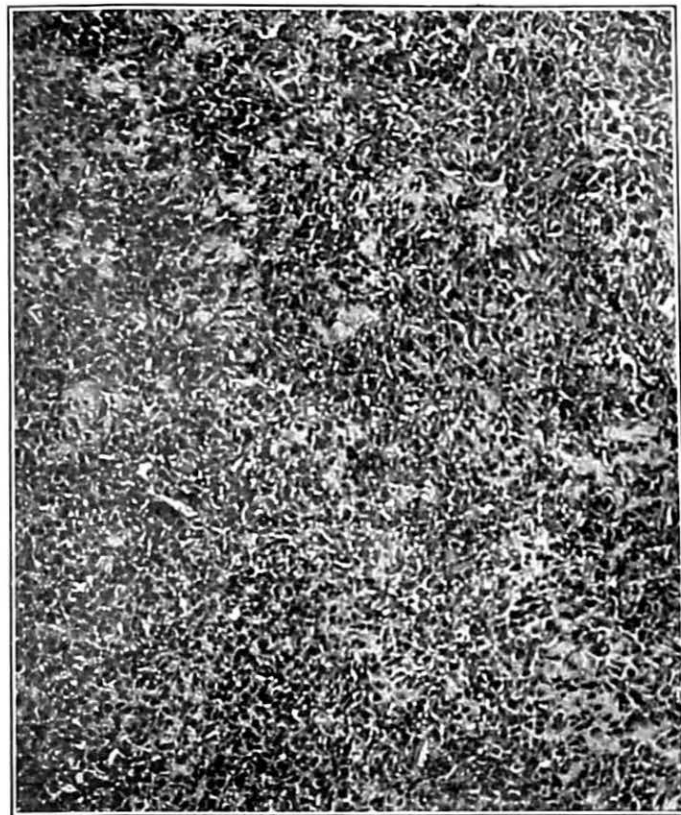


FIG. 5.

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## APPENDIX

*List of Research Centres and Local Committees.*

The centres taking part in the scheme covered by the foregoing Report are the institutions named below. Nine 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 and a few others 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 Governors of the Hospital and expenses partly by the British Empire Cancer Campaign.

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., Ch.M., 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., F.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.; 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.; C. W. Flemming, M.Ch., F.R.C.S.; and Professor E. N. da C. Andrade, D.Sc., Ph.D.

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

The Rt. Hon. Lord Horder of Ashford, K.C.V.O., M.D., F.R.C.P.; Sir Charles Gordon-Watson, K.B.E., C.M.G., 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.; J. Paterson Ross, 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.; R. F. Phillips, F.R.C.S.; 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 C. 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:**

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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, Mr. W. V. Mayneord, Cancer Hospital, London, and by Mr. Geoffrey Jefferson, Radium Institute, Manchester.

A quantity of radium lent to the Council 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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### ANNUAL REPORTS

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

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### 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.] *Out of print.*

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. 8d. (1s. 4½d.).

(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. 8d. (1s. 4½d.).

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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.).

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**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. [1917.] *Out of print.*

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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.).

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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-Claypon. [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.).

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No. 171. Facial Growth in Children, with Special Reference to Dentition. Part I, by Corisande Smyth. Part II, by Matthew Young. [1932.] 1s. 6d. (1s. 8d.).

*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.).



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- 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. [1923.] 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.).
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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.).

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- See also FOOD POISONING.

#### Encephalitis :

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

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- No. 179. Chronic Enteric Carriers and their Treatment. By C. H. Browning, with others. [1933.] 1s. 6d. (1s. 7½d.).
- See also BACTERIOLOGY ; FOOD POISONING.

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

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### Food Poisoning :

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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.

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

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**Malaria :** *see* QUININE.

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

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

**Miners' Dietsaries :** *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).

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

No. 54. The Diagnosis and Treatment of Peripheral Nerve Injuries. [1920.] 2s. (2s. 1¼d.).

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**Nutrition :**

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No. 87. Report on the Nutrition of Miners and their Families. By the Committee upon Quantitative Problems in Human Nutrition. [1924.] 1s. 3d. (1s. 4d.).

No. 105. Diets for Boys during the School Age. By H. C. Corry Mann. [1926.] 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* GOTTRÉ (No. 154).

No. 135. The Carbohydrate Content of Foods. By R. A. McCance and R. D. Lawrence. [1929.] 2s. (2s. 1¼d.).

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

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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. 1¼d.).

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. 6d. (7s. 0¼d.).

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.] 1s. (1s. 1d.).

*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. 1¼d.).

**Psychology :**

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

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

### Radium :

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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.).

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