In summarizing I would say that, in my experience, the tibial tuberosities are broken more commonly by violence directly applied to the flexed knee or by forced abnormal lateral movement than by the so-called "compression"—a term so frequently employed in describing the fractures of this region. The tuberosities appear to be fractured with about equal frequency.

Treatment.

There is such a wide variation in this group of fractures that it is absurd to dogmatize and to insist, as many writers have done, that either non-operative or operative treatment is the method of choice for all types. Each must be treated according to its particular needs.

All fractures which involve the joint surfaces must be dealt with by early manipulation under full anaesthesia, so as to restore the position as perfectly as possible. Open operation must be resorted to if a satisfactory reduction cannot be otherwise obtained. Bone pegs should be used where the fragments tend to move so as to jeopardize the adequate reposition. Small separated fragments should be excised. Fixation in plaster for an average period of six weeks has been, in my own experience, the most satisfactory means of maintaining position.

After-Treatment.

In the later treatment a strong distinction must be drawn between movement and weight bearing. Gently graduated active movement should be commenced as early as possible after union is attained, but, in the severer injuries at least, weight bearing must be delayed for at least three months by the adoption of a calliper walking splint.

The end-result, after such treatment, is frequently better than the primary injury would lead one to hope for, but the recovery of movement is usually slow, and I have many times been surprised to find how a knee which has suffered a severe articular fracture and, at the end of six months, showed 30 or 40 degrees of movement would, after another six or twelve months, regain a range of more than a right angle of free and painless movement.

This paper was illustrated by numerous radiograms, of which a small selection are reproduced as line drawings.

RADIUM IN GYNAECOLOGY.*

BY

SIDNEY FORSDIKE, M.D., B.S., F.R.C.S.

THIRTY years ago radium made an entry into surgical therapeutics, and was greeted with enthusiasm on reports of the cure of malignant tumours. Claims were made which were never substantiated, or results were so transient that recurrence of the growth followed hot-foot upon the reports. In the course of five or six years disillusionment was complete, and radium treatment was left to the few who still had faith. We are now in the second advent, and the enthusiasm displayed suggests that history is repeating itself. Responsible men are making themselves answerable for statements that 70 to 80 per cent. of early cancers are curable by radium; such claims may possibly be prophecy; they are not history. There is a glut of hastily written books on treatment by radium, and a still greater stream of reports of cases treated within the year. I recently attended a lecture by the director of a radium clinic who recorded cures of one, two, and three years' standing. What does the word "cure" mean? Is it the disappearance of symptoms for a limited time, or is it permanent freedom from disease? Assuredly the latter is the only meaning, and the propriety of using the word in any other sense is open to grave criticism. This enthusiasm, sired by our profession and nourished by the press, has placed an enormous sum of money in the hands of a Radium Commission for the purchase of 24 grams of radium element. It is proposed to distribute the whole of this for clinical work, not one milligram being allocated to biological research. One would suppose that there was

nothing unlearned of the effects of radium upon living tissues, and that, given the supply, the disappearance of the cancer was only a matter of application. A certain amount of work has been done upon normal tissues, tissue cultures, and animal tumours. The knowledge gleaned from these sources is of great value, but it must be multiplied ten, twenty, and a hundredfold before we are in a position to direct the gamma ray with precision and certainty. At present the only research radium in the country amounts to something less than a gram, privately owned and divided into small quantities; if all the problems to be investigated are to depend on this supply alone, then another generation must pass away before they are solved. These problems are urgent and imperative, and must be attacked while the wave of enthusiasm is high. The Radium Commission would serve the community to the best advantage in the organization of research work and in the allocation of whatever radium was necessary for the purpose.

How Radium Acts.

It is a matter of dispute between workers whether radium acts directly upon the cell or upon the stroma. The microscope shows us the change of structure which has taken place in the tissue after irradiation, but it tells us nothing of how or why the change has taken place. The ingenious application of cinematography, by Canti, to irradiated tissue cultures has extended the knowledge acquired by the study of the dead cell, but while we have a dramatic view of the cell being struck down it does not solve the question why it is smitten. This effect may be due to direct action on the cell by the gamma wave, but it is equally probable that it is caused by a primary change in the stroma. After a long investigation¹ of the effects of radium upon normal and malignant tissues I was forced to the conclusion that the primary action was upon the stroma, and the cell change secondary to it. This problem, however, is not to be settled by the study of structure alone; it must be combined with observation of the change of function in secreting and excreting glands after irradiation. Furthermore, the help of the biochemist must be enlisted to investigate changes in the chemistry of the cell after exposure to radium. The importance of this question cannot be exaggerated, for upon its solution depends the decision of the dose to be employed.

Screens.

One would think that the value of metal screens must have been settled long ago, and yet the following values are given in three different books for the absorption of 99.9 per cent. beta rays:

	Brass.	Silver.	Lead.	Platinum.
Cade... ..	1.60 mm.	1.30 mm.	1.20 mm.	0.60 mm.
Larkin	2.0 mm.	1.0 mm.	1.0 mm.	0.50 mm.
Simpson	1.10 mm.	0.80 mm.	0.80 mm.	0.40 mm.

Russ² has shown that with 0.5 mm. platinum about 20 per cent. of the ionization is due to the moderately penetrating rays, and they are responsible for the necrosis which occurs around the source of energy. This necrosis is either beneficial or inimical to the treatment, and therefore it is of paramount importance to ascertain the true value of the screen. Needles containing one, two, three, or more milligrams of radium element are being used for cancer of the tongue, breast, and cervix with a thickness of 0.5 mm. platinum, and the immediate results are reported to be satisfactory. On the other hand, the Radium Institutes of Stockholm³ and Paris use a minimum equivalent of 1 mm. platinum, from which permanent results are reported. It is not probable that both methods are equally favourable, and it is imperative to determine which is the more favourable. Some experiments by Lazarus-Barlow,⁴ in which he used screens of varying thickness—0.5 mm., 1 mm., 1.5 mm., and 2 mm. platinum—throw light on this problem. He found that the minimum injury to normal tissues and the maximum to actively proliferating cells was produced when the heavy screens were used. These results are crucial, but they need to be

* Read in opening a discussion in the Section of Obstetrics at the Annual Meeting of the British Medical Association, Winnipeg, 1930.

repeated and extended. A further point which needs investigation is the radiation value of the metals used for screens. Physicists tell us that 1 mm. platinum is equivalent to 2 mm. lead in screening power. Is it certain that the gamma wave which has passed through lead has a similar value to the gamma ray which has passed through platinum? Discrepancies in clinical and experimental work when using different screens of equivalent value suggest that this may be one source of error.

Split Doses.

A problem equally pressing is whether the dose should be applied continuously or divided into two or more exposures. How far do living tissues conform to physical laws? *Ceteris paribus* the ionization effects of 100 mg. of radium element for one hour are equal to 50 mg. for two hours. Does the law hold when living tissues are in question? In practice Radiumhemmet gives three large doses at intervals of ten and twenty-one days, whereas the Curie Institute gives a prolonged exposure of four, five, or six days of a smaller quantity. Can it be that both methods are equally favourable, or are we treading the radium path blindly? Some experiments recorded by Lazarus-Barlow⁵ suggest that this is a complicated problem. Using the same dose of radium, he employed a large quantity for a short time and a small quantity for a relatively long time, and found that the results upon columnar and squamous epithelium were practically reversed. He concluded that the same arrangement of time and quantity in a dose of radium produces very different effects when acting upon the three types of epithelial tissues—columnar epithelium, dry squamous, and moist squamous epithelium. Maximum effects are produced upon the epithelial cells, and minimum effects upon the associated tissues in the case of a columnar-cell growth when the quantity of radium is relatively large and the time relatively small; whereas in a squamous-cell growth the optimum effects are produced when the quantity of radium is small and the length of exposure relatively long. It is obvious that these experiments go to the root of the problem, but they need amplifying, and research work with this object must be organized.

Treatment of the Regional Glands.

Finally, the clinical problem arises as to the treatment of the regional glands. The weakness of the Radiumhemmet technique is that it relies upon uterine and vaginal radium entirely, which means that the involved glands are being treated palliatively.

Various methods of applying radium in the pelvis have been tried, from Dael's chain, implanting radium and packing the pelvis with gauze for a week, fixing radium in drainage tubes, which are brought to the surface through stab wounds, to burying radium needles for a week, at the end of which time a second laparotomy is performed to recover them. These methods are uncertain, inexact, and make a big call upon the woman's fortitude and courage. Some of these methods have been described as a "barrage of radium," an unfortunate term, for it is as likely to form a mental barrage to progress as a radiological one to exclude the cancer cell.

Recasens (Madrid)⁶ has combined x rays with radium for many years, and claims improved results over radium treatment alone. However, as far as I know, he has not published statistics in support of this claim. The Curie Institute has been using x rays as well as radium since 1923-24; a comparison of its results before and since should prove instructive. A third method is coming into use in which the treatment of the cervix by radium is followed by excision of the regional glands. It is obvious that with such varied practice there is urgent need of organized research in this direction.

RADIUM IN BENIGN CONDITIONS.

Whatever the view may be with regard to the treatment of carcinoma, there is no doubt about the efficacy of radium in producing an artificial menopause. Even here, however, there is a difference of opinion upon two important points: (1) dose of radium; (2) whether the endometrium or the ovaries are affected.

Dose of Radium.

Here we find the differences somewhat startling.

50 mg. radium element in 0.5 mm. platinum *in utero* for seventy-two hours.

100 mg. radium element in 1 mm. platinum *in utero* for forty-eight hours.

100 mg. radium element in 1 mm. platinum *in utero* for twenty-four hours.

The object we have in view in menopausal haemorrhages is to convert the endometrium into connective tissue without the production of necrosis. We find that this occurs experimentally and clinically when the hard gamma ray is used alone. A long exposure to beta rays produces necrosis of the tissues in the immediate vicinity of the radium. In the case where 50 mg. of radium element protected by 0.5 mm. platinum is placed *in utero* for seventy-two hours, 20 per cent. of the ionization effects are due to hard beta and soft gamma rays; necrosis ensues, and if it remains aseptic partial or complete obliteration of the uterine cavity occurs. Complete obliteration may or may not be desirable, but with partial occlusion there is a grave risk of pyometra. If the necrosed surfaces become infected sloughs of the endometrium and secondary haemorrhage follow, and when healing does take place it is again by way of partial or complete closure of the uterine cavity.

The larger doses of 100 mg. of radium element in 1 mm. platinum for twenty-four and forty-eight hours rarely result in necrosis, but it is quite common to hear of severe irritation of the bladder and rectum. This irritation is often transient, but it sometimes lasts for months despite all treatment, and the patient has exchanged painless haemorrhage for continuous pain and discomfort. Ascherson⁷ reports the local changes which occur as a result of these heavy doses: hour-glass contraction of the vagina, atrophy of the portio, shortening and stenosis of the vagina, and ovarian neuralgia.

In 1926⁸ I published the results of 200 cases of severe uterine haemorrhage treated by 53 mg. of radium element in a screen equivalent of 1 mm. platinum placed *in utero* for twenty-four hours, and expressed the opinion that this dose was probably unnecessarily large. Since then I have (in some cases) reduced the time to twenty-two hours, and the results are no less satisfactory; with these doses there has not been a single complaint of irritation of bowel or bladder.

Does Radium Act upon Endometrium or Ovaries?

The German view, arguing from the analogy of the Roentgen ray, that "radium acts by castration," is still widely held, despite clinical, physical, and experimental evidence. The law of inverse squares was ignored; the three and a half inches separating normally placed ovaries from radium placed in the uterine cavity was forgotten; the knowledge that the demonstrable action of radium upon tissues under similar conditions is limited to three-quarters of an inch was unknown when this argument was advanced. To settle this problem I undertook a critical investigation on the ovaries of cats, in which the conditions were precisely similar to those in clinical work. The results were conclusive in showing that the ovaries remained unaffected, and that the changes in the endometrium were alone responsible for the cessation of haemorrhage. An account of these experiments and analysis of the clinical evidence was reported to the Gynaecological Section of the Royal Society of Medicine.⁹

FIBROIDS.

Radium is used in the treatment of these tumours, but in my opinion when treatment is required at all it should be by excision, because while radium banishes haemorrhage and causes the tumour to shrink, it will not make the growth disappear. Fibroids are peculiarly liable to degenerative changes, and therefore it is advisable to remove them. The only exception is where haemorrhage is the cardinal symptom, and a small fibroid is discovered during an examination under anaesthesia; in such cases treatment by radium is justifiable.

RADIUM TREATMENT OF CANCER OF THE CERVIX.

It is slowly being recognized that the early results are not permanent in the majority of cases, and therefore not worth recording except as evidence of the value of radium for palliative treatment. Reports on a five-year basis will alone enable us to assess the true value of radium in the treatment of malignant disease, and for this purpose they are equally important, whether favourable or not.

The classification of cancer of the cervix under the international standard is not easy, for the definition which creates Classes 2 and 3 covers inflammatory as well as malignant conditions, and it is sometimes impossible to differentiate between them. My series of cases in the five-year period 1921 to 1925 consists of 211, divided as follows:

1. Cases in which the disease was limited to the cervix (operable) 14
2. Cases in which the vagina and parametrium was involved and the uterus tethered (borderline) ... 53
3. Cases of advanced disease (inoperable) 144

Operable Cases.

The following table shows the results in the 14 operable cases:

Recurrence of Growth.				Remained Free = 28%.
1 year.	2 years.	3 years.	4 years.	5 years and over.
3	4	2	1	4

Remained Free.—One patient was alive and well nine years after treatment. One died of chronic bronchitis and cardiac failure seven and a half years later. She had been treated with radium and x rays. One was alive and well six years later. The fourth was alive and well five years afterwards.

Recurrence of Growth.—In three patients recurrence took place in the cervix, and in five a pelvic mass developed while the cervix remained healed.

Borderline Cases.

In 20 of these cases the condition improved so much after the first exposure to radium that I performed the radical operation upon them. The results of the remaining 33 are as follows:

Recurrence or Death within 5 years.					Remained Free = 12%.
1st year.	2nd year.	3rd year.	4th year.	5 years.	5 years and over.
13	8	6	1	1	4

Remained Free.—In one a laparotomy had been performed at another hospital for a Wertheim's operation, but it was abandoned. She has remained under observation for eight and a half years, and is free from disease. The second was under observation for six years, during which time she remained well. The third is alive and well at the end of six years. This patient was treated with radium and x rays. The fourth is alive and free from disease after five and a half years.

Recurrence or Death within Five Years:

Case 180.—This was a carcinoma of the stump of the cervix occurring some time after a subtotal hysterectomy. Three years after treatment her right breast was removed for a malignant growth. Two years later, and five years after the radium treatment, she returned with a mass in the pelvis, but whether it was a metastasis from the breast or a recurrence from the cervix was not decided.

Case 172.—In this case the patient died from cerebral haemorrhage four years after treatment, but there was no recurrence of disease in the pelvis.

Of the 13 patients who were lost or died within the first year, one died of uraemia after one exposure, and one patient had one exposure and then underwent an operation at another hospital.

Recurrence took place in the pelvis in 10 of these cases. It is worth remarking that of the 14 operable and the 33 borderline cases, recurrence deep in the pelvis occurred

fifteen times, which corresponds approximately to the number of cases in which the glands are found to be involved.

Inoperable Cases.

Recurrences after Wertheim's Operation.—These cases numbered 40. The difficulties attending their efficient treatment by radium are insuperable owing to the proximity of the bladder and rectum, and I have derived no encouragement from my results. Temporary relief was the best sequel, and not one patient survived beyond one year. Vesical fistulae occurred in three cases, but it is not possible to say whether this was due to the growth or to the radium; it is certain, however, that a fistula would have resulted if left untreated, but it is probable that the treatment hastened the condition.

Advanced Cases.—There were 104 of these, 10 of which were not suitable for treatment on account of fistulae, metastases, or cachexia. Of the 94 treated 73 died in one year, 16 in two years, 2 in three years, 2 in four years, and 1 in five years.

At this stage of the disease there is no hope of curing the patient, but the symptoms, haemorrhage, offensive discharge, and pain are relieved in 80 per cent., and life is prolonged in comfort for 20 per cent. In the cases which survived for three, four, and five years a slowly enlarging pelvic mass was present throughout, and pressure symptoms ultimately appeared.

In this class recto-vaginal fistulae occurred in two cases and vesico-vaginal fistulae in three. In advanced malignant disease of the cervix fistulae are of common occurrence before the termination of life, and it is not possible to attribute them to the radium alone. I had to ligature the internal iliacs for secondary haemorrhage on eight occasions; in three of these cases a virulent infection was present, and it is probable that the arterial wall had undergone such changes that secondary haemorrhage was imminent, for in two of them it appeared within three days of the first exposure. In the third patient there was an interval of fifteen days between the first and second exposures, and the haemorrhage ensued immediately after the second. In the other five cases healing of the ulcer had made great progress, but had reached a callous stage in which a small unhealthy cavity was surrounded by a massive deposit of fibrous tissues.

Summary of Results.

The total number of patients treated by radium was 181. In the inoperable cases the results were: palliation and prolongation of life, 134—none cured; borderline cases, 33—4 cured; operable cases, 14—4 cured.

The rate of cure in all the cases treated by radium was 4.5 per cent., or 1 patient out of 22; in the borderline cases 12 per cent., or 1 patient out of 8; and in the operable cases the rate was 28 per cent., or 2 patients out of 7.

If the advanced cases, where no cures could be expected, are omitted there were 47 operable and borderline cases, of which 8 were cured (17 per cent.), or 1 patient out of 6.

Remarks.

These issues were not comparable to those of Radium-hemmet or to those obtained by operative surgery, and I attributed the comparative failure to an immature technique which was tentative and unsettled. Therefore in the current five-year period I adopted the technique of Radiumhemmet in one series of cases, and that of the Curie Institute in another. The latter I abandoned after treating twenty cases, owing to the production of callous ulcers which never completely healed. I persevered with the Stockholm technique, and, although the five-year period is not yet up, the conclusions do not show any improvement. I visited the Institutes of Stockholm and Paris to ensure that my methods did not differ in any material way and was satisfied that the technique offered no reason for the marked difference in results.

I remain a believer in the future of radium, but feel that to-day we are a long way from accepting it as a sovereign cure for all malignant tumours; in the meantime I am convinced that surgical treatment offers the patient a better chance of cure. Unless our knowledge of radium

is greatly increased, and the immediate results of treatment are placed in proper perspective, I foresee a general resumption of treatment by operative surgery.

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Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

NODULAR SPLENIC TUBERCULOSIS WITH GROSS ENLARGEMENT.

The fortuitous discovery of a case of tuberculous nodules of the spleen, with gross enlargement of the organ, seems to be worthy of record, in view of the rarity of such an occurrence in an otherwise healthy subject.

A youth, aged 22, met with sudden death in a motor collision in May. He had had no previous illness, and the family history was good.

At the post-mortem examination fracture of the skull was found, but there was no disease of the organs other than the spleen, which was full of nodules; these on microscopical examina-

Section of Spleen.

tion, were reported to be tuberculous in origin. They were whitish yellow, ranging in size from that of a pinhead to at least 1/4 inch in diameter. They projected slightly beneath the capsule, and also from the cut surface. On section conglomerate tubercles were revealed, with scattered giant cells and numerous epithelial cells. The larger nodules showed commencing caseation.

The case is interesting because it is rare for tuberculous infection of the spleen to occur apart from similar manifestations elsewhere. Moreover, it is unusual for such great enlargement to be caused by numerous nodules; the organ measured 6½ by 4½ by 3 inches, and weighed 9 ounces. This occurrence must be extremely rare in a youth otherwise perfectly healthy at the time of death.

I am indebted to Dr. J. A. D. Radcliffe (pathologist to the Royal Portsmouth Hospital) for the pathological report.

Southsea.

R. HAMER HODGES, M.B.Lond.

REMOVAL OF SAFETY-PIN FROM DUODENUM.

CERTAIN interesting features of the case here described justify, in my opinion, its publication.

On May 26th a male infant, aged 6 months, was brought to me by the mother, who stated the child had just swallowed a small safety-pin. The child appeared quite at ease, but an x-ray examination revealed the pin lying open to the right of the second and third lumbar vertebrae, probably in the pyloric end of the stomach. Examination of the abdomen showed no sign of peritoneal irritation, but the child was admitted to the Great Western Hospital for observation, and x-ray photographs were taken on four consecutive days. Since the pin, however, remained in the same anatomical position and continued to lie vertically, suggesting that it had become fixed in the stomach wall, I decided to remove it.

On May 29th a general anaesthetic was administered, and the abdomen was opened by an upper right paramedian incision. To my surprise I was unable to feel the pin in the stomach, but eventually it was located in the duodenum at the junction of the second and third portions. It is rather surprising that an open safety-pin can proceed as far as the third part of the duodenum before it becomes anchored. I refrained from opening the duodenum, since it is difficult to manipulate this part of the organ, especially in an infant, and also one hesitates to open it because of its liability to leakage. I therefore incised the stomach about one inch proximal to the pylorus, and attempted to coax the pin up from the duodenum into the stomach. It appears that the pylorus of an infant will just admit the little finger, but it was impossible to pull the pin up—even with the aid of forceps—owing to its being fixed to the duodenal wall. The stomach was therefore closed.

It appears that the pin was caught in the wall of the duodenum; I succeeded in completing the perforation, and in forcing out the pin as far as the head. It would have been almost impossible to incise the third part of the duodenum and to suture it successfully without fear of leakage. A purse-string suture was passed around the pin, and by means of a sharp pull the head was torn through the bowel wall; the purse-string suture was immediately tightened and tied, and the abdomen was then closed.

The child made an uninterrupted recovery and was discharged from hospital thirteen days later.

Should I ever be called upon to perform this operation again, I should make the incision at least 1½ to 2 inches proximal to the pylorus, because in suturing the wound of the stomach the pyloric sphincter was encroached upon, tending to occlude the lumen. Nevertheless, it has been my experience that in cases of perforated pyloric ulcer treated simply by purse-string suture and invagination, however much is taken up in the suture and invaginated, pyloric obstruction does not occur, and gastro-enterostomy is quite an unnecessary procedure.

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PASSAGE OF GALL-STONES THROUGH THE ABDOMINAL WALL.

THE case described by Mr. F. H. McCay in the *Journal* of July 26th (p. 142), of the natural passage of gall-stones through an external sinus, prompts me to record a somewhat similar, though perhaps even more uncommon, occurrence in a patient seen recently at the Manchester Royal Infirmary.

A woman, aged 60, gave a six months' history of gradually increasing jaundice and loss of weight, with clay-coloured stools, dark urine, anorexia, and occasional vomiting, preceded by repeated attacks of typical gall-stone colic, and extending over a period of twenty-four years. She stated that during this time she had passed through her abdominal wall at intervals thirty-four stones of varying dimensions, but usually of the size of small pebbles. They appeared singly, or in groups of two or three. Their passage was preceded by the formation of a small swelling under the skin, which, when formented, discharged the stones externally, leaving the sinus exuding a thick yellow fluid.

Abdominal examination revealed the scars of three sinuses, one in the epigastrium and two in the right hypochondrium. A large mass present in the latter region was subsequently diagnosed at operation as an inoperable carcinoma of the gall-bladder, this finding being later verified histologically.

I am indebted to Mr. P. R. Wrigley for permission to record this case.

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