RADIUM THERAPY IN EYE DISEASE.

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THE present paper is an outcome of an investigation carried out by Mr. Mackenzie Davidson and myself into the possibilities of radium as a therapeutic measure in eye disease. We have carried on the work with the limited time at our disposal for over a year, and now venture to bring forward the results obtained, in the hope that they may stimulate further inquiry and research.

A good many of the present cases were mentioned in a preliminary note published in vol. xxix of the *Transactions of the Ophthalmological Society*, but no statistical tables such as are appended to this paper were made, and all the cases are now grouped together and their special features detailed for easy inspection.

We can endorse more fully now the opinion which we then ventured to express—namely, that radium is likely to prove of great service, both in the treatment of external diseases of the eye and in those of the eyelids. The results are in many ways most encouraging, and the field of utility for radium in eye disease has widened considerably since the time that it was first shown to be a specific for rodent ulcer.

Method of Application.

The method of applying the radium was crude but satisfactory. The eye was first cocaineized and the radium, which was contained in sealed glass tubes permitting only the passage of beta and gamma rays, was applied directly to the affected part. The fingers of the operator were protected by enveloping first that part of the tube not required and then the fingers in a thick, continuous wrapping of lead foil.

The process is tedious, especially as care must be exercised to keep the tube in close contact with the part desired to treat which is often very small, but no more efficient way could be devised.

Length of Exposure and Dose.

There are two points to which we should, in the first place, like to draw attention. First—and this is of vital importance—in no single instance have we observed the slightest ill effects from the use of radium. We have, of course, exercised caution, especially when dealing with the eye itself, and it is probable that when the actions and dangers of radium are more fully understood there will be a much greater freedom in repeating the sittings than we thought advisable.

The second point is that no increase of inflammation or aggravation of symptoms occurred in any case, with the one exception of pain, to which I shall refer again later on, and which, when it occurred, was usually transient and not severe.

It is, of course, of the utmost importance, in dealing with a substance such as radium, that at the earliest possible moment positive rules as to the size of the dose to be employed and length of the sitting, as well as the frequency with which the sittings should be repeated, should be laid down for the guidance of the inexperienced.

At the present time it is unfortunately impossible to give more than a few general indications, and to point out by results obtained the most likely road to a successful issue.

With regard to the eye itself, we had no basis upon which to found our observations, so we thought the best plan would be to fix a time limit which would not endanger the integrity of the eye, however large a dose it might be considered desirable to try. Mr. Mackenzie Davidson's experience with radium here proved the deciding factor, and an exposure of five minutes was fixed as being absolutely safe.*

With regard to the dose itself, it will be obvious to anybody glancing over the appended statistics that very

many and varied doses were employed. We were chiefly guided as to dose by the character of the lesion to be treated, considering that one exhibiting a tendency to spread or infiltrate surrounding tissues, or marked by any special virulence in its progress, would probably require a larger dose than a small, superficial, or non-infiltrating lesion. Further, being anxious to try the effects of as many variations as possible, we in many cases used a different dose for the second sitting to what was employed in the first instance.

It soon became evident that lesions of the cornea could be treated successfully with this time limit of five minutes by the same dose which, for affections of the skin and lids, required an exposure three or four times as long, and also that superficial lesions of the cornea frequently do not need any more than quite a small dose, such as 5 to 10 mg., applied once or twice as the case might demand.

Looking back upon our experience, I am inclined to think, and Mr. Mackenzie Davidson agrees with me, that a supply of 20 mg. is sufficient to combat any external affection of the eye in which radium is likely to be of service.

Frequency of Exposures.

With regard to the frequency with which the exposures were repeated, we were guided entirely by the progress or otherwise of each individual case.

When dealing with a virulent and highly dangerous process, such as a hypopyon ulcer, it was obviously necessary to get a result with the least possible delay, and consequently the exposure was repeated as soon as was considered safe, if no improvement had been noted. Whereas, in milder cases, we were content to wait longer for signs of amelioration, being anxious to find, if possible, the minimum number of sittings necessary to effect a cure.

The effects of radium are continuously exhibited for a considerable space of time, extending into a matter of six weeks at least, and so some of our cases had only one sitting, and a perfect cure resulted.

The margin of safety with regard to the minimum interval that should elapse between the sittings must obviously depend upon the dose employed. The larger the dose, the sooner should its effects be produced, and the longer the interval between the sittings. Consequently, if a large dose was considered necessary at the first exposure, we seldom repeated it with less than a week's interval, except it happened to be noted that the disease continued to spread in spite of the treatment, in which case we considered that a second exposure might safely be given at a rather shorter interval.

RESULTS.

Before briefly reviewing the results obtained, it must be clearly understood that as soon as the patient was submitted to radium all other forms of treatment were as far as possible omitted. In some cases, such as corneal ulcers, it was considered advisable to continue the use of atropine and a pad and bandage, and in most cases the patient was also given boracic lotion for the purpose of keeping the eye clean. In the case of corneal ulceration it may be perhaps argued that this would to some extent discount the value of the result obtained, in that the patient might have been cured by this method of treatment alone; but, with few exceptions, the cases submitted to radium were of a kind not usually amenable to this simple treatment, and were selected on this account. Further, many of them had had previous treatment without success before radium was employed; and, lastly, a few superficial cases were undertaken to note whether radium, employed in addition to the simple routine treatment of pad, boracic lotion, and atropine, afforded a likelihood of effecting a more speedy cure.

The immediate effects of applying radium directly to the eye are practically *nil*, beyond an evanescent photophobia and irritability, which are probably simply a reflex disturbance induced by the method of application, and which would probably appear just as markedly if a stick of chocolate, instead of radium, were employed.

A few hours after the sitting a certain proportion of the patients complained of pain, which in a few instances was severe enough to cause a sleepless night. As a rule this symptom had passed away within twenty-four hours, but once or twice the patient has told us that the pain lasted more or less continuously for a couple of days. This,

* With regard to this point, I may say that Mr. Mackenzie Davidson, in dealing with rodent ulcer affecting the lid border, found that a tube of 20 or 30 mg. could be applied to the inner surface of the lid, and so lie in contact with the sclerotic for a period of half an hour without causing any ill effect to the eye.

I think, is the longest period in any instance. As a rule the pain was not at all severe, and it has been differently described by patients, some saying that it was of a throbbing character, whilst others described it as a numbing sensation. A large proportion experienced no pain at all.

In only one instance did a patient complain of any sensation referable to the retina, and that occurred in a case of episcleritis—one of the first cases which we treated—in which the application of a very large amount of radium (59 mg.) had been employed for five minutes to the sclerotic. This patient said that after the application she was much troubled for the space of an hour or so by the appearance of flashes of light proceeding from the side opposite to that treated. After this once passed off there was no return of symptoms, nor has there been any evidence of impaired function since. With reference to the production of this symptom, it is worth noting that if a tube of radium is placed against the closed lids in a darkened room a faint, though quite definite, sensation of light is imparted to the observer.

After the initial discomfort, if any, has worn off, the patient usually experiences a rapid improvement in the subjective symptoms from which he had previously suffered, and this speedy anaesthesia, if it may be so called, is a very striking feature of the treatment.

With regard to affections of the lids and of the eye other than those involving the cornea, a much longer exposure with a large dose (20 mg. or more) was borne without any expression of subsequent discomfort, and, if the part to be treated involved the skin, a dose of 30 mg. applied for fifteen minutes will only produce a subsequent sense of itching and heat over the treated area.

With regard to the more remote effects of applying radium to the eye, it is very gratifying to be able to say that in not a single instance did we obtain any untoward inflammatory exacerbation as the result of treatment.

A certain number of cases did not respond at all to the radium, but in those that did so the effect produced was simply that improvement became manifest, rapid or slow as the case might be, without any characteristic clinical signs.

A noticeable result of treatment by radium is the character of the scars produced, which are best exemplified in cases of spring catarrh. They are perfectly supple and smooth, and do not exhibit the slightest tendency to cause cicatricial dragging; but they are very strikingly bloodless, and the tarsal surface of the lid after the cure of a case of spring catarrh presents a very blanched appearance.

Before closing, I should like to make a few remarks with regard to the statistical tables which are appended as a supplement to this report.

The cases selected for treatment may be divided into four groups.

1. Ulcerations of the cornea.
2. Non-ulcerative acute inflammations of the cornea and sclerotic.
3. Affections of the lids.
4. Corneal scars.

We purposely did not attempt cases of a kind readily amenable to simple forms of treatment, such as phlyctenular keratitis, nor did we try the treatment on trachoma. Perhaps some apology is needed in this respect, but our time was unfortunately very limited, and it had already been shown that trachoma could be cured by exposure to α rays. We felt that in this case radium would almost certainly be shortly proved to act as a specific for this disease, the more especially as it is so successful in the treatment of spring catarrh; and I, for one, venture to hope that this paper will result in an extended trial of radium for the treatment of trachoma, employing a similar kind of exposure and dose to that found successful in dealing with spring catarrh.

Corneal Ulcers.

The first 17 cases in the tables deal with various corneal ulcerations. The results obtained were universally good with one exception, and that was Case 16, where, I think, the failure was due to continuous infection of the ulcer by the septic condition of the lids. The latter, in accordance with our rule, were not treated whilst trial of radium was being made. It will be noted that not a few of the cases

were treated successfully with a very small dose (5 mg.) applied once or twice. The rapidity with which improvement followed the first exposure to radium was a striking feature in nearly every case, as was also the rapidity of the healing as soon as it had commenced.

In no case, with the exception of that already quoted, did the ulcer continue to progress after radium had been used, although the length of convalescence necessarily varied very considerably.

Non-ulcerative Inflammations of the Cornea and of the Globe.

Seven cases of acute interstitial keratitis are reported. It is very difficult in a disease of this sort to make any dogmatic statement, with so few cases on record, and we therefore leave the cases to speak for themselves. However, one or two rather striking results were obtained.

In case No. 20 one eye was treated with radium and the other eye, which was attacked soon after the first, was not so treated. The eye in which radium was employed made a much better recovery than the other, the cornea showing barely a trace of the old complaint, whereas the other cornea has a well marked central haze.

In case No. 21, the attack of interstitial inflammation, which was caught in its earliest stage, certainly did seem to be cut short by radium, and the symptoms never became acute, whereas in the other eye, which was previously affected and not treated by radium, the inflammation was of a severe description, and the patient was under constant treatment for six months.

Case No. 26 (recurrent episcleritis), which was a typical case of a most troublesome disease, is worth mentioning, because the improvement after radium was used was so extremely marked in every way. The patient expressed herself to me a week after radium had been used as feeling more comfortable than she had done for months.

Case No. 27 (keratitis profunda), which was an excellent example of a comparatively rare condition, is also interesting. This patient came under my observation a month after the loss of sight had commenced. Various remedies had been tried without the slightest effect, and the case was handed over to me on this account, as the patient was getting restless, and threatening to go to Wiesbaden, where tears are wiped away from all eyes.

Case No. 40.—This case of recurrent inflamed pterygium was quite one of the most striking illustrations of the power of radium to reduce inflammatory processes. The patient has, during the whole of the treatment, continued his work in a gunpowder factory, exposed to the fumes which have no doubt been the essential factor in producing and maintaining the condition. The condition was regarded as hopeless when the patient was sent for treatment.

Affections of the Lids and Corneal Scars.

There is one point to which I want to draw special attention, and that is the continued success of the treatment of spring catarrh. There is, I think, no doubt that, for this disease at least, radium acts as a specific cure.

Mr. Mackenzie Davidson has two more cases under his care at the present time, both of which are doing well. Large doses of radium, however, appear to be essential.

Case No. 33 had a good trial with a 5 mg. tube without the slightest benefit, and it is certain that a long exposure with a small dose will not produce the same result as a large dose given for a short space of time.

Our attempts to deal with the removal of fine, downy, ingrowing lashes was not a success, though much patience was exercised in the effort. Nor was the treatment of old corneal nebulae productive of much obvious benefit. It is, however, possible, seeing that two of the four patients were very positive of improvement, that large doses of radium applied continuously at intervals of three weeks or so, over a long period of some months, might effect a radical and permanent increase in the vision, and more extended effort might be made in this class of case.

Finally, the great drawback to the more general use of radium is its present prohibitive price. It is to be sincerely hoped that this will in the near future be considerably lower, so as to come within the means of the ordinary man.

The present system of cornering the supply and amassing it in institutions which can utilize it as a means of obtaining prodigious fees is most prejudicial both to the prestige of the profession and to public interest.

No.	Name.	Age.	Sex.	Nature of disease.	Number of exposures and dose.	Result.	Remarks.
1	G. S.	53	M.	Hypopyon ulcer	2 exposures of 29 mgrm. tube. First exposure for 5 minutes. Second exposure for 2 minutes 1 week later	Cured	Ulcer caused by wound from metal 7 days previously. Large central infiltrating grey ulcer with small hypopyon. Hypopyon much smaller the day following first application; quite gone on third day. Ulcer quite healed with small grey facet 14 days after first exposure.
2	J. B.	22	M.	Hypopyon ulcer	1 exposure of 29 mgrm. tube for 3 minutes	Cured	Ulcer caused by injury from fragment of mortar. Small circular ulcer just below pupil with small hypopyon. Hypopyon had disappeared on the third day, and the ulcer no longer stained to fluorescein.
3	W. C.	23	M.	Corneal ulcer with vascular fasciculus and pannus	2 exposures of 5 mgrm. tube for 5 minutes with an interval of 3 days between the applications	Cured	Patient had had several previous attacks of inflammation. There was a nebula occupying a large area of the cornea with a moderate degree of pannus and a small superficial erosion near the centre. The pannus had quite disappeared and the patient quite well, except for the nebula, 11 days after the first application.
4	T. S.	65	M.	Corneal ulcer with vascular fasciculus and pannus	2 exposures of 5 mgrm. tube at an interval of 3 days	Cured	A case much like No. 3. Recurrent attacks of inflammation extending over many years. The cornea was largely nebulous and moderate pannus was present with much general irritability. Ung. flav. was tried before radium, but it did no good. 10 days after first exposure the eye was white and subjective symptoms had disappeared.
5	M. T.	61	F.	Corneal ulcers	1 exposure of 29 mgrm. tube for 5 minutes	Cured	Patient gave history of painful inflamed eye for 3 months. Much injection of bulbar conjunctiva, with two patches of corneal ulceration of an infiltrating character. One patch was large, oval in shape, and about 3 mm. in length and 1 mm. in diameter. 2 days after exposure the ulcers did not stain to fluorescein. Bandages removed 6 days after exposure. The resulting nebulae were extremely faint.
6	D. B.	43	M.	Corneal ulcer	2 exposures of 5 mgrm. tube for 5 minutes at interval of 7 days followed by 1 exposure a week later of 39 mgrm. for 5 minutes	Cured	A case of deep ulceration resulting from breaking down of an old scar, the result of injury several years previously. The exposures of the 5 mgrm. tube had no effect, but the ulcer quickly healed after the strong dose of 39 mgrm. In this case there was deep ciliary injection and some iritis.
7	C. S.	—	M.	Corneal ulcer with large hypopyon	1 exposure of 49 mgrm. for 5 minutes. 1 exposure of 59 mgrm. for 5 minutes 10 days later. 1 exposure of 39 mgrm. for 5 minutes 3 weeks later	Cured	An exceedingly bad case. A dirty yellow, spreading ulcer of cornea with large hypopyon and a muco-purulent discharge from lids, which were injected and chemosed. A corneal paracentesis was performed before radium was tried, as the condition was extremely urgent, but the patient did not improve much. 13 days after paracentesis the lower third of cornea was densely infiltrated and sodden, with some bulging present. Improvement was rapid and continuous immediately after the first exposure to radium. Very large doses were used, as the case was so bad, but no pain or reaction followed any of the applications and a sound, excellent scar resulted with the pupil fairly active. $V = \frac{1}{10}$.
8	E. H.	30	F.	Herpetic ulceration of both cornea	2 exposures of 5 mgrm. for 5 minutes with an interval of 4 days	Cured	Both cornea were dotted with multiple punctate staining areas, the result of the rupture of vesicles. In the left eye the central two thirds of the cornea after douching stained deeply to fluorescein. In this eye there was also a linear ulcer with some surrounding infiltration. 4 days after the first exposure there were still a few staining points, but the linear ulcer was healed over. 4 days after the second exposure both cornea were quite healed. 11 days later there was an acute muco-purulent conjunctivitis with some relapse of staining at a few points, but the patient quickly recovered with a weak lotion of zinc sulphate.
9	J. B.	49	M.	Vascular faceted ulcer of cornea	1 exposure of 5 mgrm. for 5 minutes	Cured	A deep central faceted ulcer with a staining area of 2 mm. diameter and a good deal of surrounding infiltration of the cornea. There was severe pannus and much injection of the globe. The patient rapidly improved after exposure and was quite well a fortnight later. The ulcer was the result of a second attack of inflammation, and there was some iritis.
10	E. J.	17	F.	Mooren's ulcer	2 exposures of 29 mgrm., the first exposure for 5 minutes and the second, a week later, for 3 minutes	Cured	There was a history of repeated attacks of inflammation for 18 months. The present attack had lasted a fortnight. There was a grey haze of rather varying density, with numerous new vessels extending over the upper two thirds of the cornea with an advancing irregular line below, which stained to fluorescein. 6 days after exposure there was no staining and the eye was quiet. 1 day later there was a little pink injection of the eye, and it was considered advisable to use radium a second time. Patient was last seen a month later, when the eye was quite well.
11	C. W.	20	M.	Recurrent vascular ulcer of cornea	3 exposures of 5 mgrm., the second exposure 2 days after the first, and the third exposure 4 days after the second	Cured	The present was the third attack of inflammation in 6 months, and the eye had never got quite well between the attacks. There were 2 punctate superficial erosions with many grey maculae dotted over the upper portion of the cornea. Pannus was considerable. 2 days after the first exposure there was much less injection and only one minute staining point. 7 days later the patient was quite well except for a little pink injection about the corneal limbus.

No.	Name.	Age.	Sex.	Nature of disease.	Number of exposures and dose.	Result.	Remarks.
12	M. S.	26	F.	Recurrent erosions of cornea; herpes of cornea	59 mgrm. applied for 5 minutes. Patient was cured for a time. Relapse 2 months later, when the other eye also became affected. 1 exposure of 49 mgrm. to first eye for 5 minutes, and 2 exposures of 49 mgrm. to the second eye with interval of 13 days	Cured	This case had been under treatment off and on for 14 months before radium was tried. The patient suffered from repeated attacks of superficial ulceration and pannus affecting both eyes and different portions of the cornea. The attacks consisted of eruptions of small staining areas near the limbs with superficial pannus and much irritation and photophobia. Radium produced immediate relief of symptoms with rapid healing, but in each eye there was a relapse after treatment which necessitated a second exposure. The patient has not come for examination for over a year so presumably has kept quite well.
13	A. B.	49	M.	Traumatic ulcer	2 exposures of 5 mgrm. for 5 minutes with an interval of 3 days	Cured	5 days previous to exposure the cornea was wounded by a chip of concrete. There was a large deeply staining abrasion roughly circular and measuring 5 mm. in diameter. The surrounding cornea was deeply infiltrated at two points. 3 days after the first exposure the staining area measured 1 mm. in diameter and 3 mm. in length. 7 days later the cornea did not stain and the patient was practically well.
14	F. W.	19	F.	Dendritic ulcer of cornea	1 exposure of 29 mgrm. for 5 minutes	Cured	A typical case of dendritic ulcer. There was a history of a simular attack of inflammation of the cornea six years previously which had lasted for 4 months. The cornea presented several irregular wavy lines of grey ulceration which intersected here and there. A week after exposure there was no staining and no subjective symptoms and the eye seemed quite well.
15	A. G.	42	F.	Catarhal ulcer of cornea	1 exposure of 5 mgrm. for 5 minutes	Cured	This patient had suffered from a relapsing conjunctivitis for 2 months. The ulcer formed a deeply staining, sudden spot near the limbus. As in other cases, all treatment except bandage and boric lotion and atropine was discontinued after radium, but the ulcer quickly healed. The lids, however, suffered a good deal from the bandaging and want of effective treatment, and subsequent astringent applications were necessary.
16	C. Q.	62	F.	Deeply inflaming yellow ulcer of cornea	2 exposures of 29 mgrm. for 5 minutes with an interval of 14 days	Failure	This case was complicated by the condition of the lids, which were in a very septic condition. The exposure in each instance caused a great deal of pain, lasting for some hours. After the first exposure the ulcer showed no tendency to spread, but it did not heal and a second exposure did not seem to benefit. A great deal of trouble was experienced in curing the lid inflammation, and under treatment in this direction the ulcer slowly got well.
17	S. G.	35	M.	Central ulcer of traumatic origin	2 exposures of 29 mgrm. with an interval of 5 days; the first exposure was for 5 minutes and the second for 3 minutes	Cured	There was a history of injury 4 days previously. The cornea stained over an area measuring 2 mm. in length by 1 mm. in breadth, and there was a surrounding area of deep grey infiltration 4 mm. in diameter. The pupil was sluggish with marked ciliary injection. 5 days after the first exposure the ciliary injection was much less and the cornea did not stain.
18	M. R.	18	F.	Marginal keratitis	1 exposure of 29 mgrm. for 5 minutes followed by a second exposure a fortnight later of 29 mgrm. for 1 minute	Cured	A few days later the patient was practically well.
19	E. W.	15	F.	Interstitial keratitis; tuberculous; both eyes affected	Several exposures to doses varying from 49 mgrm. to 15 mgrm.	Doubtful	There was a large area of the limbus of the cornea red and swollen with much photophobia and lachrymation but no staining. The first exposure caused much pain for 2 days, and then the eye began to improve rapidly and appeared almost well 9 days after exposure. No further radium was given for a further 5 days on account of the pain caused by first application. The second exposure was scarcely necessary, but the patient was then not quite well.
20	M. B.	24	M.	Interstitial keratitis; congenital specific disease	1 exposure of 15 mgrm. for 5 minutes	Improved	A most obstinate and difficult case. Patient had been under treatment at the Central London Hospital for 18 months before coming under observation, and had been attending Moorfields Hospital for over a year before radium was tried. At first radium seemed most successful and rapid improvement followed, but relief was not permanent. Successive relapses were treated, but beyond producing a temporary amelioration it is doubtful if radium proved of much service.
21	A. R.	17	F.	Interstitial keratitis; congenital specific disease	5 exposures of 29 mgrm. for time varying from 3 to 5 minutes	Improved	A typical case of specific interstitial keratitis. Had been treated for 5 weeks by the usual methods of fomentations, etc., but did not improve and subjective symptoms were acute. Rapid improvement set in at once after radium, and without any relapse the eye got well with barely a trace of corneal haze. About 6 weeks after exposure the other eye became affected and was not treated with radium. This eye has since made a good recovery, but though the disease did not run a more severe course there is a considerably denser resultant haze over the centre of the cornea.

The patient was convalescent from an attack of interstitial keratitis in one eye for which she had been treated for 6 months. The other eye then showed signs of a commencing attack, and it was resolved to try to abort the attack with radium. In this some success was certainly made. The symptoms seemed to come to a standstill, and at no period did this eye show any acute inflammation. Within 3 weeks the sclera was quite white, but a certain amount of corneal haze remained and still persists.

No.	Name.	Age.	Sex.	Nature of disease.	Number of exposures and dose.	Result.	Remarks.
22	N. W.	24	F.	Interstitial keratitis; congenital specific disease	8 exposures extending over 3 months, with doses varying from 5 mgrm. to 20 mgrm. applied for 5 minutes	Improved	Patient had been treated for 3 weeks on general lines before radium was tried. Symptoms were exceedingly acute, and patient grew continuously worse. It is difficult to say to what extent radium benefited, but certainly the case began to make rapid strides towards recovery after the first exposure, which was a cautious one of 5 mgrm. for 5 minutes. The exposures were then made almost weekly with increasing doses, and the patient thenceforward made steady progress without any relapse. A small dense central nebula persisted.
23	E. G.	15	F.	Interstitial keratitis; congenital specific disease	5 exposures extending over 5 weeks, with doses ranging from 15 mgrm. to 20 mgrm. applied for 5 minutes	Doubtful	A severe typical case of interstitial keratitis with intense photophobia and lachrymation. Improvement seemed at first to follow the exposure to radium, but a severe relapse set in a few weeks after the radium was discontinued, with recurrence of pannus and photophobia.
24	T. C.	7	M.	Interstitial keratitis; congenital specific disease	1 exposure of 50 mgrm.	Improved?	An unusually severe case of interstitial inflammation affecting both eyes. The child had been under treatment for 4 months before radium was used. Both cornea were extremely opaque and vascular, but the child was steadily mending. The exposure was given to <i>one eye only</i> to compare results if any. No reaction followed the large dose employed, and the eye chosen was much the more opaque. The opacity in this eye appeared to clear much more rapidly after the use of radium than was the case with the other eye; but it is impossible to speak more definitely.
25	H. S.	26	F.	Recurrent episclerites with sclerosing keratitis	1 exposure of 50 mgrm. for 5 minutes to the episcleral swelling	Cured	The present attack was the second in the right eye, and there had been a similar attack in the other eye. The inflammation had already lasted 2 months, and was accompanied by severe subjective disturbance. There was great injection, with deep violet discoloration and swelling. A fortnight's treatment on the usual sedative lines and salicylate of soda was tried without any improvement resulting. The exposure to the large dose of radium caused severe pain, and the sensation for an hour or so of almost continuous flashes of light proceeding from the side of the globe opposite to that treated. After exposure to radium all treatment was omitted. Two days later the patient was already much better. A week after exposure she was nearly well. She then contracted influenza, and there was a slight recrudescence of symptoms, but they soon passed away without any further treatment, and the patient made a steady convalescence. The patient has not been seen for nearly 12 months, and presumably has remained quite well. On account of the severe disturbance following the large dose of radium it was considered inadvisable to employ it a second time. Probably a quicker convalescence would have resulted after a second much weaker exposure. This was the worst case of its kind I have experienced. In spite of every kind of treatment that could be devised both cornea sloughed, and one eye had to be removed. The other eye ultimately quieted down, but the whole cornea remained densely opaque. Radium was tried as a last resort in this eye, when the sloughing had ceased, in the hope of producing some clearing of the opacity. No reaction followed the exposures, but the treatment did not produce any noticeable result.
26	H. M.	23	M.	Interstitial keratitis; congenital specific disease	4 exposures of 20 mgrm. for 5 minutes with intervals of 1 week	Failure	A very interesting case. Five weeks previous to use of radium vision began to rapidly fail without apparent cause. There was a central grey plaque situated in deep corneal layers measuring 8 mm. in diameter. Surrounding cornea healthy. Subjective symptoms slight. Vision much affected. A month's treatment with fomentations, etc., had effected no improvement. A week after first exposure the plaque was smaller and less dense and vision improved. No reaction followed radium, which was continued for a month. Two months after last exposure an exceedingly faint nebula, about one third the size of the original plaque, was still visible.
27	M. B.	20	F.	Keratitis profunda	4 exposures of 20 mgrm. for 5 minutes with intervals of 1 week	Much improved	A most successful case. Patient had had 6 operations of transplantation during 3 years with no permanent benefit. When he first came under observation there was a very large, inflamed pterygium, forming a broad, succulent swelling, with large corneal involvement. The subjective symptoms were marked and the patient was in constant and extreme discomfort. The effect of radium was immediate and marked. No reaction or pain followed the large doses employed, but the inflammation and subjective symptoms rapidly subsided, and the pterygium began to shrink. After 3 months the bulbar conjunctiva had resumed its normal appearance, but over the corneal portion there was still a little juicy-looking swelling and some slight pannus. Nothing further was done for 4 months and no relapse occurred, but as a little pannus and swelling still persisted a few more sittings were given. At the present time no radium has been used for 4 months, and the patient is quite cured except for a slight degree of pannus at the corneal limbus.
28	S. C.	40	M.	Inflamed pterygium	6 exposures of doses varying from 30 mgrm. to 50 mgrm. extending over 3 months with about fortnightly intervals. No further treatment for about 4 months; then 3 further similar exposures during the ensuing 6 months	Cured	

No.	Name.	Age.	Sex.	Nature of disease.	Number of exposures and dose.	Result.	Remarks.
29	W. F.	31	M.	Bilateral pterygia partly cured by excision	1 exposure of 49 mgrm. and later of 59 mgrm. applied through 13 mm. of lead foil	Cure completed	Patient had had successful operations for removal of large bilateral pterygia a year previously. The bulbar conjunctiva, however, remained red, rather chemosed, with continued irritability of both eyes, photophobia, and constant slight diplopia due to dragging of the conjunctiva on one side. The first exposure caused a good deal of intermittent pain for 2 days, and the second exposure was made through lead foil in the hope of preventing this from occurring again, and this was successful, as no pain was experienced. The first exposure produced rapid improvement in the subjective symptoms, and the eyes were much less red a week later. At the expiration of a fortnight the diplopia had quite disappeared, and the eyes were nearly white. The patient then went to West Africa, and was not seen for a year. On his return he stated that he had remained quite well for 6 months, but then slight redness of the bulbar conjunctiva on the right side appeared, and has continued ever since. The other eye remained permanently white and free from discomfort. Patient was just off again to West Africa, and nothing further was done. The patient was a captain in the Merchant Service, and had to return to sea before the effects of radium could be satisfactorily tested. No reaction or discomfort followed the exposures, and the pterygium seemed to us to be shrinking, but no positive statement can be made.
30	J. W.	38	M.	Pterygium (not inflamed)	2 exposures of 29 mgrm. for 5 minutes with an interval of 1 week	Doubtful benefit	A case of large pterygium, with extensive corneal attachment and considerable irritability of the conjunctival portion. It was resolved to see if small doses of radium would have any effect. No effect of any kind was noted, and we should have then proceeded to larger doses, but the patient presumably tired of the treatment and did not attend. The case is reported as evidence that probably large doses are needed to produce marked effect in cases of this sort.
31	C. S.	48	M.	Inflamed pterygium	2 exposures of 5 mgrm. for 5 minutes with an interval of 1 week	Failure	This case has already been fully reported (<i>vide</i> 'Trans. Ophthal. Soc.' vol. xxix, p. 239). The length of time occupied by the treatment was due to caution through lack of experience. The boy has since remained quite well.
32	L. B.	12	M.	Spring catarrh	8 exposures of doses varying from 39 mgrm. to 44 mgrm. and extended over 12 months	Cured	An extremely bad case, which had been under observation and treatment for over 3 years, without any benefit. The upper tarsus of each lid was extensively infiltrated with characteristic flat outgrowths. The right lid was treated first. Under cocaine, scissors were used freely to remove as much of the growths as possible, and to well freshen the surface. Very little could be got away. A week later 49 mgrm. were applied for 20 minutes, and the same dose and exposure was repeated again 3 weeks later. A month after the first exposure the condition was already much better, and then two sittings were given in one week of 49 mgrm. for 10 minutes. No more radium was used for a month, when one sitting of 29 mgrm. for 15 minutes was given. 2 months later a final exposure of 29 mgrm. for 15 minutes was made, the lid being then almost well. 6 weeks later the lid was examined, and no trace of the former trouble was apparent, the tarsus being quite smooth, without any appearance of cicatrix, except that there was a certain bloodless appearance in places. Treatment of the left was not commenced until the right lid was nearly well, and no previous shaving of the outgrowths was made. A similar method of treatment has been adopted in other respects. The lid is now practically well, but is still being kept under observation, and possibly one or two more sittings may be required. It may be mentioned that weak doses of radium (5 mgrm.) were tried 3 or 4 times without success before the patient came under our observation.
33	B. R.	30	M.	Spring catarrh	Right. — 6 exposures to right lid extending over 4 months: 49 mgrm. for 20 minutes twice; 49 mgrm. for 10 minutes twice; 29 mgrm. for 15 minutes twice Left. — Similar treatment to right.	Right cured Left improved	
34	E. M.	40	F.	Rodent ulcer	3 exposures of 16 mgrm. for 10 minutes, the first 2 exposures with a week's interval, and the third about a month later	Cured?	A small rodent ulcer, situated on the face about 1 inch below the inner canthus. It was freely excised, but there was an obvious return of the disease in the scar a few weeks later. The patient was then sent for treatment by radium. No reaction until a week after the second exposure, when the scar was raised and reddened, and there was some pricking pain. This subsided in about a fortnight, leaving the scar white, supple, and free from infiltration. The patient was last seen 6 months later, and has remained free from recurrence.
35	F. K.	77	M.	Rodent ulcer	2 exposures of 29 mgrm. for 15 minutes, with an interval of 1 week, and a third exposure of 29 mgrm. for 10 minutes about a month later.	Cured?	Typical rodent ulcer, involving whole of lower ciliary border, with much loss of surface at inner canthus, where the ulceration is severe. 8 weekly applications of 5 mgrm. for 5 minutes had been given before the case came under our observation. Some benefit to the outer portion of the growth had resulted, but the inner worse part had not improved. The condition was much improved a week after the first exposure to the larger dosage, and the ulcerated area thenceforward rapidly cleared up. 2 months after the first exposure he seemed to be cured, and a supple scar was alone to be seen. Patient has not since reported himself.

No.	Name.	Age.	Sex.	Nature of disease.	Number of exposures and dose.	Result.	Remarks.
36	O. S.	7	F.	Small nevus on cheek just below lid margin	2 exposures of 29 mgrm. for 10 minutes, with a fortnight's interval	Cured	No reaction for about 3 weeks after the first exposure, when the spot became redder and inflamed. Repeated small superficial scabs then formed and re-formed, with final healing delayed for a few weeks. 6 months after treatment the only indication of the trouble is a minute pink speck surrounded by a small area of blanched skin.
37	M. M.	14	F.	Pigmented papilloma of ciliary border	2 exposures of 29 mgrm. for 11 minutes with a week's interval	Cured?	A hard, nodular, pigmented swelling noticed for about 2 years, and though small, causing considerable disfigurement. Reaction to radium first noticed a week after the second exposure, when a scab had formed with a mild surrounding inflammation. No further radium was given as reaction was rather severe. A month later there was still a vestige of the growth left, but shrinkage was going on. The ciliary border on each side of the growth was entirely denuded of lashes.
38	M. A.	19	F.	Granuloma of lower lid	2 exposures of 29 mgrm. for 5 minutes with 1 week's interval	Cured?	For 7 or 8 months an increasing growth had been noticed on the palpebral surface of the lower lid. It formed a round sessile tumour, smooth on surface, which was covered by conjunctiva and apparently growing in connection with the tarsus. It was very hard to the touch and painless in character. A piece removed showed it to be composed purely of granulation tissue. 10 days after the second exposure the tumour had almost disappeared. The effect of radium in this case was simply to produce a rapid shrivelling of the growth. The patient was last seen a month later, when there was still a vestige remaining, consisting of a flat scar, but no obvious growth.
39	E. W.	37	F.	Angioma of ciliary border	3 exposures of 29 mgrm.; 1st exposure for 25 minutes, 2nd exposure a week later for 15 minutes, 3rd exposure 7 weeks later for 15 minutes	Much improved	A blood-cyst measuring 5 mm. in diameter and elevated about 2 mm. above the ciliary border. Noticed for 10 years, and lately increasing in size. It produced great disfigurement. Reaction was first noted 3 weeks after the first exposure, when a crust had formed over the angioma, which had shrunk considerably. A fortnight later the crust came away, leaving an inflamed scar. A month later the lid had quite healed, but as there was still a small but definite remnant of the growth radium was used once more. When last seen there was still a very small red swelling with the lid border denuded of lashes in the neighbourhood. It was not deemed advisable to use radium again.
40	H. R.	44	M.	Trichiasis (old trachoma)	—	Failure	These 3 cases were examples of that variety of trichiasis where the lashes as a whole do not brush the cornea, but where there are a few or several very fine downy colourless cilia scattered along the lid margin and setting up much irritation. Electrolysis is extremely difficult, and the lashes are so fine that the patient or friends cannot see to pull them out for themselves. An attempt was made to deal with the difficulty by treating the lid border with radium applied directly to the faulty lashes. The trials given were not a success. To ensure a good result a long and direct exposure is necessary, and after several endeavours it was found practically impossible to directly apply a tube of radium to a fine lash for a period of 15 minutes. Further, the lashes in the immediate neighbourhood are apt to suffer, so that a patchy baldness of the ciliary border may be produced in the attempt to rid the lid of one or two fine hairs.
41	M. B.	76	F.	Ditto	—	Failure	These 4 cases represent an attempt to deal successfully with the amblyopia caused by central corneal nebulae. It is difficult to express an opinion as to the value of the treatment. In each case the patient after a few sittings expressed himself as being able to see more, and in Cases 43 and 46 there was definite objective evidence that the nebula was less dense. Attempts, however, to measure improvement in vision by test-types did not show conclusive proof of amelioration. It is certain that if any success is to follow the treatment of corneal scars by radium the exposures must be continued over a long period of time, and the dosage must be fairly large.
42	E. H.	46	F.	Ditto	—	Failure	
43	A. M.	14	M.	Large and dense central corneal nebula	Several exposures in each case to both large and small doses	Doubtful	
44	W. B.	50	M.	Ditto			
45	M. W.	31	M.	Ditto			
46	W. S.	24	M.	Ditto			