A Lecture ON RADIUM IN SURGERY.

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BY

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MR. HOLLAND, MR. FENWICK, AND GENTLEMEN,—It has appeared to me, as it has appeared to many, that there is the possibility of a great future for radium in the domain of surgical therapeutics. I say *possibly*, because radium is a new remedy, and one must exercise the very greatest caution in speaking of the potentialities of a new remedy. A new remedy is a thing of great expectations and of very ready promises, but sooner or later it must be inevitably associated with a measure of disappointment. I need not remind you of the expectations which were aroused on the introduction of the x rays; they were to revolutionize surgery. Well, they have not done so. But the x rays have accomplished a marvellous work. And yet it is not perhaps unsafe to say that we are within sight of that point where the limitations of the x rays in treatment will be found. The same applies to the high frequency current. That measure was to cure practically every human ill; yet I think I am right in saying that the expectations formed of it have not been realized, and that those who hoped so much from it may feel that they are to a certain extent in the position of false prophets. So also with the Finsen light. There never was a more splendid enterprise in hospital administration than the introduction of the Finsen light into this hospital. The good it has done it is impossible to express in ordinary language; but yet, I imagine, we are not very far from reaching the actual limit of the good that is to be effected by that measure. On the present occasion I have not to preach to you any new doctrine. I merely wish to place before you a *précis* of the present position of this subject of radium in surgery, and to state the facts which seem to justify us in supposing that the utility of radium is likely to be great. I will first of all, if you please, speak of the maladies that radium can cure, then of the method in which radium acts, and, lastly, of the lines upon which the investigation of its powers is likely to proceed. First of all with regard to the cases which radium can cure. In this connexion I do not propose to deal with published cases, although the literature of the subject is large enough; I propose only to speak of patients whom I have actually seen and personally examined. The majority of these were seen in the Paris Institute, and I should like to say how deeply obliged I am to Dr. Louis Wickham, the Director of the Institute, for his courtesy and kindness in allowing me to see the work of that institution.

Let us deal first of all with angiomas, using the term in its widest sense. It may be said, and I think without hesitation, that radium will cure every form of naevus. It can cure the "port-wine" stain, and I would ask surgeons at the present day what measure they have available of which they can say the same. It can rid the patient of a pigmented mole, of a hairy mole—two troubles practically incurable if the size be beyond certain limits. In connexion more definitely with naevus, let me take four illustrative cases. One is that of an infant with a naevus on the crown of the head the size of a gooseberry. There is no means of dealing with such a growth except by operation. It was cured by a comparatively short application of radium. Here is another case, a little more striking—a girl with an angioma of the eyelid the size of a plum. This had been subjected to four operations; twice it had been excised, twice it had been treated with the actual cautery, but with no benefit. It was perfectly cured by radium without trouble or discomfort to the individual. Perhaps a more striking case is that of a young woman who had a naevus occupying nearly the whole of one

side of the face. She had been subjected to innumerable operations, but with only very imperfect success, I should almost say with no success. But under the influence of radium—and the treatment was, of course, long extended—she was cured. The last case I will trouble you with under this head is also remarkable. It was that of a child of 12 with a fibrous angioma situated in the substance of its arm, free from the skin, which was uncoloured and sound. The mass was of the size of a hen's egg. It was treated with radium from two sides, and was entirely dispersed in four weeks. It is, I am bound to confess, a little astonishing that a solid mass of such magnitude, not a mere subcutaneous growth, should have vanished so readily. I may here remark that it seems possible to say of radium that there is a relation evident between the amount of radium used and the good it can accomplish. Until now, considering the little quantity of radium available, it means that we are dealing with a substance which may be regarded as limitless. You cannot say that of x rays, of the high-frequency current, or of the Finsen light, for they, at least, seem to have reached the limit of their powers. It would not, perhaps, be unsound to draw the conclusion from that that if you could have radium enough you could carry out surgical measures far beyond the confines to which radium is at present restricted. With regard to skin affections, you probably know well enough the effect of radium in curing chronic local eczemas, and especially forms of eczema associated with itching. Nothing is more curious in the use of radium than the manner in which it immediately cures, and apparently permanently cures, itching when placed over the surface on a piece of varnished silk. Then radium can cause keloid to vanish; the keloid left by a wound, the keloid left by tuberculous glands, and that obstinate form known as the acne keloid. For instance, I saw in Paris a man, about 30 years of age, the nape of whose neck had been in an appalling condition from acne keloid; apart from the disfigurement produced, the incessant distress made his life almost unbearable. This man had subjected himself to many forms of treatment, but with practically no result. Under the influence of radium the condition had disappeared, and the skin had become almost normal in appearance. I will say nothing about vanishing glands in certain cases where radium has been used, because that may be quite accidental, and it would be premature to draw conclusions from the occurrence.

Now we come to rodent ulcer. Radium will cure rodent ulcers. Of what grade? Rodent ulcers which have existed for many years, in which the tissues have become adherent to the bone, or apparently to the bone, in which there is ulceration, and in which—and this is the most important point of all—in which the Finsen light, the x rays and cataphoresis have all been tried and have all failed.

Such cases—and there are many of them—may be cured by two sittings of radium lasting one hour each, the parts being finally left free from attachment to the deeper parts, the skin being soft and pliable. Why I lay stress on such cases as this is for this reason: it has been said radium only acts by means of the x rays, which are part of its radiation. Anyhow, here are cases, numerous enough, in which a condition is cured which has refused to heal after persistent treatment by x rays. In other words, radium can effect a cure where x rays cannot.

With regard to epithelioma of the tongue and epithelioma of the lip. They are cured by radium. You say of what degrees? I acknowledge that the cases are in the early stages of epithelioma; but they are epitheliomata that are ulcerating, and that, so far as we know, can yield to no other treatment except that of operation. If, therefore, an epithelioma of the tongue can be cured by radium, and cured to the satisfaction of those who are responsible for the case, it is a case of epithelioma treated without operation. Many of these I have seen. And you will notice in the present issue of the BRITISH MEDICAL JOURNAL a paper showing the treatment carried out by Dr. Dominici, in which it will be evident to you that epitheliomata of some degree, and one might say almost extensive epitheliomata, have been treated with a measure of success. The same remark applies to commencing epitheliomata on the inside of the mouth. With

regard to epithelioma of the face, I can speak of these cases seen in the Paris Institute. An epithelioma of the face which had perforated into the nasal passage; that was cured after a good many sittings. An epithelioma of the ala nasi, which was destroyed under the influence of radium after sittings which amounted in all to eight hours. An epithelioma of the cheek the size of a two-shilling piece cured and the surface healed over.

You may ask, But are these results permanent? They apparently are. It is true that no great amount of time has yet elapsed; but I saw one case in Paris where an epithelioma of the face cured by radium was perfectly sound at the end of two years. We await with interest the extension of this measure of treatment to malignant disease of the uterus and rectum.

Now, with regard to the action of radium. Radium is obtained from pitchblende, a compound of uranium, and I show you specimens of it obtained from Joachimstal. In appearance, while it is not unlike pitch, it is a little more like anthracite coal. Here is a piece of pitchblende with a little of the rock with it. Here is a seam of pitchblende as it runs in the igneous rock in which it is found. Here, again, is a specimen of pure uranium. Uranium plays a very large part in the manufacture of radium. Radium has, as you know, never been isolated; what we speak of as radium is the sulphate, the carbonate, or the bromide of radium. It appears as a whitish powder, and that powder becomes later on a little yellow, and then perhaps a faint brown. There is radium in this glass tube, and it has turned the glass violet, because it is soda glass. If this had been potash glass it would have turned it brown. On exposure of the glass to heat the colour vanishes. At present the commercial value of radium is artificially very high. If radium ever sank to such a degree of cheapness that it was worth its weight in mere gold it would be exceedingly cheap.

You know, of course, that radium gives off heat, that it is phosphorescent, that if it is dissolved in water it decomposes the same into its component parts; but the main property is that it is radio-active. Radio-activity means that the rays given off by radium have the power of penetrating solid and opaque substances, the power of affecting a photographic plate, the power of producing fluorescence, and the power of rendering air or other gas a conductor of electricity. These rays are of three kinds, known as the alpha, beta, and gamma rays. The alpha rays and the beta rays are composed of material particles or ions, which carry a charge of electricity. That they are material is shown by the fact that the power of these rays is lost when they are passed through cotton-wool. The alpha rays are composed of ions of fair size, having a mass equal to that of an atom of hydrogen. They carry a charge of positive electricity, they are deflected only by an intense magnetic field, they have little penetrating power, and a relatively slow velocity. The beta rays, on the other hand, are composed of ions of smaller size, having a mass equal to only $\frac{1}{1836}$ part of that of an atom of hydrogen. They carry a charge of negative electricity, are easily deflected by a magnetic field, have great penetrating power, and move with a very high velocity. The gamma rays are of a different type. They contain no ions; they carry no electric charge; they are consequently not deflected by a magnetic field; they have enormous penetrating power, and their velocity is about the velocity of light, with which they are comparable. When I tell you that in surgery some of these rays do harm and others do good, you will see how desirable it is to have some acquaintance with the three types of rays.

With regard to general qualities, the alpha rays may exist alone. For instance, polonium, a radio-active substance discovered by Madame Curie, and named after her own country, contains only alpha rays. Alpha and beta rays are absolutely distinct and independent; they can exist the one without the other. But the beta rays and the gamma rays are inseparable, they are never found dissociated. The alpha rays are supposed to give off the heat, and they burn. They are capable of producing a very troublesome ulcer of the skin. They have greater ionizing power than the beta rays, probably as 100 to 1. The penetrating power of these three kinds of rays is expressed as follows: Taking the penetration of the alpha rays as 1, they are stopped by a sheet of mica. The beta rays have a penetrating power of 100, and will pass

through a centimetre of lead. The penetration of the gamma rays, on the same basis, would be represented by 10,000, and will pass through one inch of steel. The alpha, beta, and gamma rays have a very close resemblance to the rays which are met with in the vacuum tube used in the production of the x rays. I had this vacuum tube brought here for this purpose. When the current is running through the tube the "cathode rays" pass from the cathode or negative pole to the anode or positive pole.

They correspond to the beta rays of radium. If you take the five qualities of the beta rays as above given, those same qualities are found in the cathode rays. They carry ions which have a mass about equal to the thousandth part of that of an atom of hydrogen, they carry a charge of negative electricity, they are deflected easily by a magnetic field, they have great penetrating power, and their velocity is very high. The x rays are dependent upon the cathode rays, and are inseparable from them in the same sense that the gamma rays are inseparable from the beta rays. Where are the equivalents to the alpha rays in this vacuum tube? If holes are made in the cathode, streams of light pass back in the opposite direction. These are called the "canal rays," or the "diacathode rays." And their qualities are the same as those already given as characteristic of the alpha rays.

The next question is with regard to the application of radium in treatment. The main feature in the application of radium is surface. It is ridiculous to attempt to apply radium as a broken up bead in a glass tube without any notion of the amount of alpha and beta and gamma rays you are using or how far the radiation extends. In applying radium surgically you want surface. In other words, a little radium spread over an even surface is much more powerful and can be much more exactly used than a bead of it in a glass tube. The power of any prepared plate of radium can be estimated by the electrometer with precision. Here are three specimens of the type of apparatus as now used in the Radium Institute in Paris. They are adapted for various localities and are of varying radio-activity.

The strength, by the way, of radium is estimated by taking uranium as a unit. Radium is then represented by a radio-activity of 2,000,000; a piece of "quarter-strength" will therefore have a radio-activity of 500,000. The powdered radium, when placed on the disc or plate, is covered with a varnish, which is unaffected by boiling, by alcohol, or by the heat of a sterilizer. In this specimen are only 10 mg., but every milligram is available. Put the same quantity into a glass tube, and the agent is almost useless. Radium can be mounted on "gum elastic," as in the uterine stems employed, or it can be spread on silk or cloth, or on anything which can be varnished.

Radium must be ordered by a definite prescription. For the individual case a plate of a certain diameter is ordered, and the proportion of alpha, beta, and gamma rays required will be stated in the prescription. The alpha rays may have to be cut off. How? By a certain thickness of aluminium, a very thin plate. Then comes the question of the distance; how close should the plate be held? The closer it is held the more intense is the effect, but the narrower the area of action. How long shall it be applied? Radium of this type I now show can be applied for about an hour at a time. Dr. Dominici, has made special use of the ultra-gamma rays, the most penetrating rays of all, and allows them to act for hours at a time. This limited action is secured by screening the plates that what passes through into the patient's body are only the ultra-gamma rays, those of the most intense velocity and the greatest penetrating power. There is a still more curious thing with regard to radium. Suppose this to be a closed glass vessel in which you have suspended a tube containing a solution of radium, or a salt of radium. If you put into that vessel a penny, that penny becomes radio-active. This is not due to the rays coming through the glass of the tube. Screen the tube with any thickness of lead you like, and it will make no difference, the penny will still become radio-active. This induced radio-activity is due to something which comes out of the tube, and that something is the "emanation." If you break the glass globe with which the experiment is made you find every bit of it is radio-active. Take the penny out and it is radio-active and

remains so for a considerable time. Scrub the penny with emery powder, and it loses its radio-activity. Test the emery powder used, and behold it has become radio-active. Wash the penny with nitric acid and it loses its radio-activity; evaporate the nitric acid and the residue left is radio-active. In brief, there comes off from radium an emanation, or if you like a vapour, which has the power of rendering any body it touches radio-active. There is no method of inducing radio-activity except by the emanation, and it is evident that this emanation leaves on any surface it touches an active deposit—a deposit which you can take off and remove.

It is probable that much of the future of radium as regards surgery lies with the emanation. This active deposit forms on any surface exposed to the emanation. By increasing the surface so exposed you increase the amount of radio-activity.

As I have been very careful not to mention any fact other than what I have myself seen, I wish to state the following as a thing told me: An eminent scientist in London has used a solution of this active deposit as an injection into the tissues of the body, for it is easy to get a solution of that deposit. This solution was injected into a mouse which was the subject of an abdominal cancer produced artificially, and the growth vanished. It is scarcely fair to mention this case, because I can add no further details. Such an experiment needs to be verified and supplemented by many other data. I have noted the local effects of subcutaneous injections of the solution of the emanation in the human subject. I will not give you details of the case, because the issues are misleading, and open up a wide subject into which I need not now go. Each injection performed in this patient with an ordinary hypodermic syringe produced a scar and pigmentation of the skin such as I have never met with in my whole surgical experience. The appearance at the site of each puncture was entirely new to me, and led me to think that I was viewing a condition of scar which had hitherto been unknown.

I will now conclude by pointing out the lines upon which the future investigation of this subject will probably extend. First of all, it is very essential to ascertain the action of the radium rays and of the emanation upon bacteria and their products. In the next place, the selective action of the radium on certain tissues must be studied. This selective action is one of the most astonishing things about radium as illustrated by the manner in which it picks out vascular tissue for destruction. Under its influence this tissue, as met with in the angioma, vanishes. What is radium likely to do for other conditions associated with vascular growth? What is it likely to do for Graves's disease? Has it any kind of selective effect upon embryonic tissue, which is allied to that of certain growths? All that has yet to be ascertained. Then comes the effect of radium in large amount. On this question of the amount great possibilities appear to hang. Little has yet been done, except by Dr. Dominici, to ascertain the effect of introducing radium into the substance of a growth in a tube permeable to its rays, such as a tube of thin aluminium. So far as he has investigated the matter the results have been encouraging.

Then come the questions of the effect of the emanation if inhaled, the effect of injection into the diseased parts of a solution of the emanation, the utility (if any) of radio-active water and other substances rendered potent by radium.

Finally, let me once more warn you against raising false hopes in discussing the potentialities of a little-known remedy.

A PETITION promoted by the Betterment of London Association to the Prime Minister requesting early legislation to check unnecessary and objectionable street noises has been signed by a large number of medical men residing in the West End of London.

THE second international course of legal psychology and psychiatry will be held at Giessen, April 13th to 18th, 1909. The course will be under the direction of Professor Sommer, who will have the co-operation of Professors Mittermaier and Dannemann of Giessen, and Professor Aschaffenburg of Cologne. All communications on the subject should be addressed to Professor Dr. Sommer, University of Giessen.

Observations

ON

HUMAN GLANDERS:

WITH A STUDY OF SIX CASES AND A DISCUSSION OF THE METHODS OF DIAGNOSIS.

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WITHIN the last few years five cases of glanders have been admitted to the wards of the Westminster Hospital. The disease, in its different types and stages, presents such diverse clinical pictures, and diagnosis is so often difficult, that there is warrant for recording these cases at some length.

This article was almost complete in 1905, but after making a study of 134 cases reported in the literature, an exhaustive treatise by Robin of Montreal appeared with an analytical report of 156 cases, including most of ours. Hence we did not feel justified in burdening the literature with a repetition of what had been so well done in Robin's thesis, but preferred to await further cases to enable us to investigate several points that had occurred to us. So far no other case has come into our hands, but many have been diagnosed recently in London, and we are firmly convinced that with a better knowledge of the protean symptomatology many will be revealed which otherwise would be overlooked. There can be no doubt that the Registrar-General's statistics, which show glanders as a rare disease, are misleading, and considerably underestimate the incidence of this disease.

CASE I.

H. A. L., aged 25, horsekeeper. Admitted November 12th, 1904, under the care of Mr. Spencer.

On October 31st fell in the stable and hurt his ribs; for this he was strapped. Two days later went to a dentist with an "alveolar abscess"; "cellulitis" developed, and for this he was treated at various places; no incision was made. On November 9th nodules appeared on the limbs, more or less in the neighbourhood of the joints, the knees more especially. Next day, 10th, a pustular eruption broke out on the neck, trunk, and limbs; the buccal mucosa sloughed, and a nasal discharge appeared; the upper part of the face became swollen. On admission temperature 103.4° F.; respirations 38. Restless, low delirium; no expectoration, no diarrhoea. The glandular lesions were of three types: (1) A diffuse, brawny, dark-purplish swelling of the face and neck, (L.) involving the temporal portion of the left conjunctival sac; the advancing edge erysipelatoid. (2) A pustular eruption, distributed without special reference to aspect, upon face, neck, trunk, and limbs; the lesions consisted of a clear yellowish-white matter head upon an angry red areola. Upon the left cheek these pustules ultimately became confluent, and, breaking down, left a large honeycombed, ulcerating surface. (3) Multiple subcutaneous and intramuscular nodules apparently in the course of the lymphatics; these nodules reddened superficially and broke down; but in no case did the skin actually give way over them. One or two were incised for diagnostic purposes; the pus was thick, yellow, curdy.

Abdomen normal. Splenic dullness increased, but edge impalpable.

Breath sounds altered chiefly in respect of prolonged expiration; there was no sign of consolidation; no gross added signs; the sounds might be described as "wheezing."

There was some articular pain, but the joints were not distended. There was no enlargement of the axillary, inguinal, or cervical lymphatic glands. The tongue was not furred, but the mucosa of the cheeks was extensively ulcerated. Muco-purulent discharge from the right nostril. Sensation, general and special, undisturbed.

The temperature kept above the 103° line until a few hours before death, which occurred on November 14th, at 6 a.m.

Thirty-two horses became glandular, and it is worth noting that seven days elapsed after the first appearance of symptoms in the man before a diagnosis of glanders in the horses was made.

Pathological Findings.—Examination of the pus from a superficial abscess during life revealed polymorphonuclear leucocytes, and after prolonged search and careful staining a few typical *B. mallei* and no other organisms (Fig. 6);