RECENT DEVELOPMENTS IN THE TREATMENT OF CANCER.

(*Continued from page* 217.)

We print below the third instalment of a Lecture on "Recent Developments in the Treatment of Cancer," delivered by Dr. Stanley Wyard, M.D. Lond., Assistant Physician at the Cancer Hospital, Fulham Road, S.W., and Fellow of the Royal Society of Medicine, at the British College of Nurses, 39, Portland Place, London, W.

THE LECTURE.

(*Continued.*)

Next in importance to surgery is radiation treatment which consists of applying to the malignant cells the rays generated by an electric current in certain circumstances or emitted by certain natural substances. A suitably constructed apparatus—technically called a tube—is furnished at one end with a metal rod, and at the other with a metal disc. Between the two is an interval or gap. The tube is air-tight, and either exhausted of air so that it is completely empty, or the air is replaced by an inert gas, ordinary air will not do. If now a very powerful electric current be passed into the rod it will leap across the gap and impinge upon the disc. In doing so it generates rays which spread out in all directions and are called X-rays. The rays consist of regular undulations or waves, and the length of the waves varies between quite wide limits. X-rays are part of a series of rays which occur in nature. As you probably know, if a ray of white light falls on a prism it is split up into its component colours and shows a series of colours commencing with red and passing through orange, yellow, green, blue and indigo to violet. These are the colours of the rainbow which consists of sunlight split up by passing through minute drops of water suspended in the air. The same effect is often seen in the bevelled edge of a mirror. The series of colours is called the spectrum, and it is found that all the colours are due to waves of different lengths, the red being longer than the orange, the orange than the yellow, and so on. These are the visible waves, there are many others which are invisible, *e.g.*, beyond the red rays are the long wireless waves up to hundreds or thousands of yards in length. Between these and the red are the heat rays. Beyond the violet rays come the ultra-violet rays which are shorter still; beyond these are the X-rays, and shorter even than X-rays are the γ-rays of radium which are amongst the shortest waves known to us.

The shorter the waves the greater their penetrating power. Thus ultra-violet rays will not pass through a sheet of tissue paper, while X-rays will pass through a block of wood. The wavelength of some X-rays is greater than that of others, and the shorter waves are said to be soft, the longer ones are hard. The penetrating power of a ray is the inverse of its absorption, *i.e.*, soft rays are readily absorbed by the tissues of the body and therefore do not penetrate deeply. The harder the ray the less it is absorbed and so the deeper it penetrates, but even the hardest rays are absorbed to some extent. It is clear, then, that soft rays, being readily absorbed, exert the greater part of their effect on the superficial tissues, especially the skin, and on all such tissues as they reach they exert a very powerful effect so that exposure to them for more than a very short time results in a burn of greater or less severity according to the length of exposure. Such burns are characterised by (1) Latency of appearance. The burn does not immediately show itself—hours or even days may elapse before it is evident. (2) Their resistance to healing. As they are slow to appear so they are even slower to heal, and it may be many months before healing is complete. The first effect is a reddening of the skin which is sore and tender. Then a blister appears which eventually bursts and leaves an ulcer with a hard indurated base. It is extremely indolent, and when at last it heals it leaves a pigmented scar with extensive induration round about. Even without burning, prolonged treatment with too large a dose may cause great disfigurement by the appearance of dilated and congested venules over the part irradiated. It is, further, a very important point to remember that irradiation produces a practically permanent alteration in the nutrition of the tissues, so that if an operation be later performed and an incision made through a part which has formerly been exposed to X-rays, it is highly probable that the wound will fail to heal and when the stitches are removed, will gape open without showing any sign that the two sides have attempted to unite.

Hard rays are less liable to burn the skin, but if applied for a long enough time will do so. In the treatment of malignant disease it is therefore usual to give a number of exposures with the rays each time directed on the tumour, but from different directions. In this way the tumour gets the largest possible dose, while no one area of skin receives sufficient to do it harm. It is, of course, impossible to produce a beam of only hard rays, some soft rays must inevitably be mixed with them. To exclude the soft rays and prevent their injuring the skin a suitable filter is placed between the tube and the patient. This filter consists of some material, such as paraffin-wax, which allows the hard rays to pass through, but absorbs the soft ones.

As I have said, X-rays pass through many substances, just as light passes through glass. The soft tissues—muscle, fat, etc.—cause little obstruction to them, but bone absorbs a large part of the rays, and therefore casts a shadow on a photographic plate, thus making it possible to photograph them while still in the living body. Other substances also are opaque to X-rays, *e.g.*, lead, bismuth, barium, and so, if the stomach be filled with a salt of any of these elements (barium is used in practice because there is no danger of poisoning with it) it will cast a shadow just as a bone will, and the size, shape and position of the organ can be determined.

When X-rays impinge upon an object they are deflected turned aside from their original direction, just as is a tennis-ball that hits a wall. Further, when a tennis-ball hits a wall and rebounds, it comes back at a slower speed than it had before hitting the wall; and in the same way X-rays, after hitting an object, leave it at a slower rate, *i.e.*, the wavelength is increased. The waves after being turned aside are called secondary rays, and are softer than the original rays, so that their penetrating power is much less. Bone and all metals, *e.g.*, lead emit secondary rays when X-rays fall on them, and it has been suggested that these secondary rays may play an important part in the treatment of malignant disease.

It has been found that the different cells of the body vary in their response to X-radiation, *e.g.*, liver-cells are readily destroyed by X-rays, they are very radio-sensitive. Muscle cells, on the other hand, are only very slightly radio-sensitive, or, in other words, are radio-resistant, so that no harm results if they are exposed to large doses. It is commonly said that malignant cells approximate to liver cells in this respect and that X-rays rapidly destroy them, but this is not conclusively proved and may not be true.

The aim of X-ray treatment is obviously to expose the body to such a dose as will destroy all the malignant cells without damaging the normal tissues which surround them. At one time it was thought that it might prove possible to do this and search was made for a lethal dose of X-rays, a dose which will kill cancer cells, while leaving other cells unharmed. Very soon, however, it became abundantly clear that such a dose does not exist. X-rays passed into a human body suffering from cancer exert a dual action—