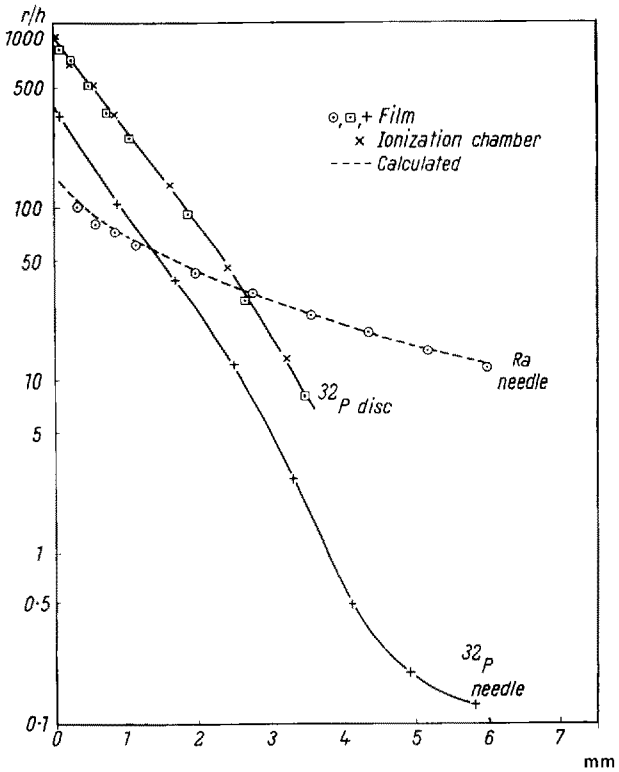
Dose Measurements with Photographic Films on a Beta-Ray Needle

The clinical use of thin-walled tubes containing a beta-ray emitter has already been reported[1], and it is evidently of some importance to know the dose-rates delivered by such tubes at the surface and at a depth in tissue. Because of the source geometry, the measurement of these dose-rates with ionization chambers is difficult, and a film method such as has already been used on plane beta-ray sources[2], is more likely to meet with success. The purpose of this note, reporting the results of some measurements made with films on a beta-ray needle loaded with phosphorus 32, is to demonstrate that films may be used with a reasonable degree of accuracy to measure the dose-rates from beta-ray tubes and needles.



Variation of dose-rate with distance from surface of sources in cellulose acetate.

The needle was a hollow duralumin tube (external diameter 2 mm; wall thickness 0·2 mm), closed with a point at one end, and having a tight fitting plug at the other. The internal space, 2·5 cm long, was filled with phosphorus 32 solution. The film used for the measurements was Ilford Industrial F, the suitability of this film for dosimetry having already been demonstrated[3]. Each film was exposed separately in a plane parallel to that of the needle, with different thicknesses of cellulose acetate absorbers (density 1·32 g/cm³) in between. Films were also exposed similarly to a 1 mg radium needle (active length 15 mm; external diameter 1·85 mm; filtration 0·6 mm Pt.), and to a disc of phosphorus 32 plastic, 22 mm diameter and 0·5 mm thick. Each batch of films was developed in Ilford ID 19 developer together with a series of films that had received standard gamma-ray exposures from a 25 mg radium tube. For these standard exposures, the films were sandwiched between layers of Perspex 6 mm thick, and set up in a Perspex jig at distances varying from 14·5 to 65 cm from the tube for a period of about 16 h. By this means a series of known exposures from 0·8 to 16 r were obtained. After processing, the films were densitometered with an EEL Universal Minor Densitometer using a 1 mm spot size. Readings of density were then converted to dose in roentgens by comparison with the films that had received known doses from the 25 mg radium tube.

The results are shown in the Figure. The estimated dose-rates on the phosphorus 32 plastic were in good agreement with values measured on the same disc with a shallow thin-windowed ionization chamber having a collecting volume 1 cm in diameter by 1 mm deep. The validity of the film technique for beta-ray dosimetry was thus confirmed. Film measurements on the 1 mg radium needle agreed well with values calculated using SIEVERT's integrals taking into account oblique filtration. This agreement supported the view that the film method might be especially suitable for the dosimetry of line sources. Finally, the measurements on the beta-ray needle, made when its activity was about 160 μc, showed very clearly the limitations of this form of therapy for other than very superficial conditions. By comparison with the radium needle, the dose fell off extremely rapidly with depth, and, as was to be expected from geometrical consideration, the half-value depth (0·45 mm of absorber, equivalent to 0·56 mm of tissue), was a little less than that for the disc-shaped beta-ray source.

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Department of Radiotherapeutics, University of Cambridge, December 4, 1956.

Zusammenfassung

Es werden Messungsergebnisse mitgeteilt, die zeigen, dass die photographische Filmtechnik geeignet ist, Dosismessungen an linearen Betastrahlern (Nadeln oder Tuben) vorzunehmen.

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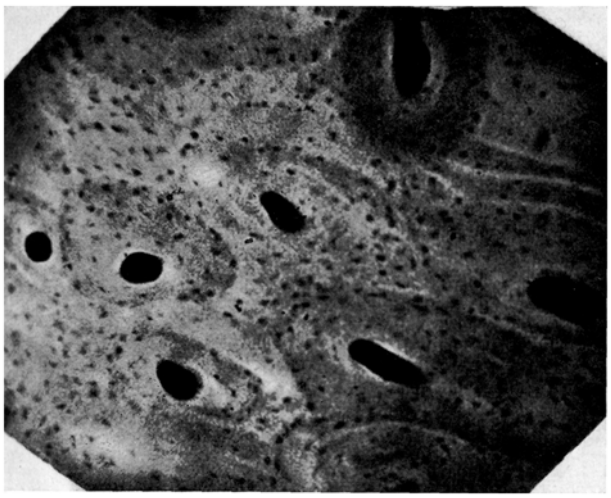
A Microradiographic Study of Bone Tissue in Ovarian Dermoid Cyst

Dermoid cyst is a teratoma and one of the common tumors of the ovary. The cyst has a yellow colour, a doughy consistency and its wall is lined with a cubical epithelium. The contents of an ovarian dermoid show many variations. Mostly it is a yellowish, turbid, oily material containing hair and skin (hence the name dermoid). One often sees bone, teeth, cartilage, thyroid, brain, intestine, striated muscle, adrenal, etc.

The origin of an ovarian dermoid is supposed by some authors to be one of the ova of the ovary. Another theory supposes the dermoid cyst to arise from one of the original blastomeres formed by the primary segmentation of the ovum, which has become separated and included in the ovary[1].



Bone tissue in an ovarian dermoid cyst has been studied by a microradiographic technique. Sections of about 30μ have been exposed to X-rays of the wavelength 2·4–4 Å. (A Machlett tube AEG 50 with 1 mm Be filter, has been used.) Within these limits calcium has one of its absorption edges (K-edge at 3·06 Å). Other components of bone show here a very slight absorption. Because of this the microradiogram shows the calcium distribution in the specimen. (Film used: Kodak Spectroscopic Plate 649.)

The figure demonstrates that there is well differentiated bone tissue in the dermoid cyst. Compact regions with Haversian systems of different ages are to be seen. Systems which are old show a higher degree of mineralization (light in figure) than those which are young (darker in figure). Regions also appear with a more spongy structure. The figure shows a microradiogram of bone tissue in an ovarian dermoid cyst from a woman of 40 years of age.

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Zusammenfassung

Die Verteilung von Kalzium im Knochengewebe in ovarialen Dermoidzysten wurde mit Hilfe der mikroradiographischen Technik studiert. Dabei konnten Havers'sche Systeme in verschiedenen Mineralisierungsstadien, die eine gut differenzierte Entwicklung des Knochengewebes andeuten, gesehen werden.

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Evidences of Cytological Basis of Differentiation

Recently, with the discovery of the endopolyploid nature of differentiated cells[1], attention has been directed towards chromosomal control of differentiation. But it is yet problematic how different degrees of polyploidy can account for qualitative differences between different organs.

Investigations on this problem, carried out on plants of different groups in this laboratory[2], have revealed the presence of chromosome numbers different from the normal *2n* ones in differentiated organs. Of the numerous plants so far worked out, the results obtained from three species of *Menispermaceae* are discussed here. The particular differentiated organ studied in the present case was the leaf.

The *2n* chromosome number, as studied from the root-tip cells, is twenty-six in *Tinospora cordifolia*. In the meristematic region of the stem-tips of this species, varying chromosome numbers have been observed, namely, twelve, thirteen, fourteen and twenty-six, the last number occurring with the highest frequency. The occurrence of such varying numbers in the meristematic portion seems to involve somatic reduction, as in a number of cases, clear thirteen and thirteen chromosomes (not chromatids) in anaphase could be seen. In the leaf, on the other hand, thirteen chromosomes are found to be the number present in all the cells. The thirteen chromosomes of the leaf do not represent the haploid complement, as is clear from a glance at their chromosome morphology. The lower numbers in the stem-tip do not represent the haploid set, implying thereby that the reduction in number occurs at random.

In *Stephania hernandifolia*, the numbers in the stem-tip vary from eighteen, twenty to twenty-two and the number present in the leaf-tip is twenty. In *Cocculus villosus*, similar variant chromosome numbers have been found in the stem-tip, such as, eighteen, twenty and twenty-two and the leaf-tip number is eighteen. The reported *2n* numbers of both the species, as counted from root-tip cells, is twenty-two. For a study of the chromosomes of leaf and stem-tip, a special technique[3] had been devised, which is awaiting publication.

In order to have a check of the chromosome number at the meristematic regions of the roots of all the three species, they were carefully reinvestigated. It was found that there too, although the reported numbers occur in the highest frequency in most of the cells, cells with other numbers are present, although with lower frequency.

The chromosomal control of differentiation is, therefore, clear from these investigations. It may be considered that the meristematic regions have the potentiality of differentiating into different organs. The differentiation is effected through the entrance of different chromosome numbers into specific organs of the plant body. There must be a screening or selective mechanism operating within the body, which is yet to be explored.

It may be postulated, therefore, that:

(1) Differentiation is controlled through chromosomes.

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