The 'Random' Ratio

Observed double recombinations occur in a wide variety of ratios and the role of the 1:1:1:1 ratio is not as a prediction, but as a normative criterion by which to judge the presence of mechanisms controlling the alignment of adjacent exchanges on the 4-strand set. It is customary, if a set of events is thought to occur at random in a particular context in a conceptual scheme, to set up a hypothesis based on a certain expected frequency of these events. Any significant deviation from these expected frequencies is assumed to indicate the presence of an additional control operating within the context but not a necessary member of it. How are the expected frequencies determined? In what way are they 'random'? And on what basis? If each one of a set of events conceptually distinguished in the model is assigned an equal probability then the set of these probabilities are often said to represent a 'random' expectation. Since probabilities are assigned only on the basis of a conceptual model, it follows that the 'random' ratio depends on the specific conceptual model. There are several conceptual models which may be used to distinguish double exchanges. Consider an array of four chromatids distinguished only as two sets of sister-strands. When two nonsister exchanges occur, three types of double exchanges may be observed although there are four distinguishable arrays (Fig. 1). (Since no further distinction among the chromatids is made, these arrays are drawn with the 'left' exchange occurring between the two center strands without loss of generality.) If these four arrays are assumed to occur with equal probabilities, the ratio of double exchanges is 1:1:1:1. (If all four chromatids are distinguished a single nonsister exchange can occur in 4 ways, making 16 kinds of double exchanges and the resultant ratio becomes 4:4:4:4.)

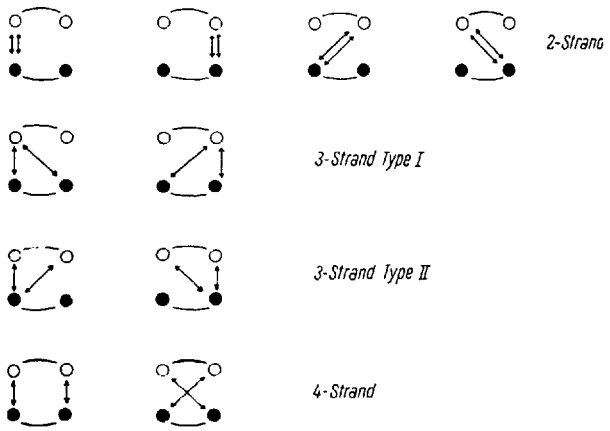

Fig. 2.

If all four chromatids are distinguished but the order of the exchanges is *not* distinguished, it is not possible to tell which is the 'left' exchange. (To avoid the bias of 'ordering' the two exchanges, the chromatids are drawn in cross section (Fig. 2) with sister strands opposite from each other, their ultimate connection to the same centromere being indicated by a thin arc drawn between them.) If each of these arrays is assumed to be equally probable, the random ratio becomes 2:1:1:1. This model is as valid as that in Figure 1. There is no *unique* 'random' ratio. It follows that chromatid interference is defined in terms of a deviation from an *arbitrary* ratio which merely reflects the bias of accepting the first model. There is no 'right' model and it is meaningless to ask whether cross-overs 'really' behave according to the first model or the second, since these models are only utilized to obtain a normative standard from which 'deviant' behavior of crossing-over is measured.

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Biological Research Laboratory, Southern Illinois University, Carbondale, July 11, 1957.

Zusammenfassung

Der Nachweis des Vorkommens von Chromatideninterferenz erscheint dadurch erschwert, dass sich die bei fehlender Interferenz zu erwartende Häufigkeitsverteilung von Zwei-, Drei- und Vierstrang-Doppelaustausch nicht eindeutig formulieren lässt, indem von verschiedenen Modellvorstellungen ausgegangen werden kann, welche verschiedene Häufigkeitsverhältnisse voraussehen lassen.

A Microradiographic Study of Ovarian Dermoid Teeth

Teeth are common constituents of ovarian dermoid cysts, but although such dermoid teeth have been examined histologically in some detail, and their gross radiographic appearance reported with some frequency, an account of their microradiographic structure appears to be wanting. The present report was prompted by other microradiographic studies dealing in particular with the nature of bone tissue in ovarian dermoid cysts[1], and in general with the calcification of cementum and dentin[2], as well as the vascularity of the developing and adult human tooth[3].

The material studied consisted of ground sections (15–25 μ) made from dermoid teeth. The teeth which were eight in number, were slightly yellowish in colour, and embedded in a bony plate that resembled the body of a miniature mandible. In general appearance, size, and shape they imitated normal oral teeth, so that incisors, canines, premolars and molars could be identified. Even though the general course and symptomatology of ovarian teratoids is usually remarkably poor in specific characteristics it was unfortunate that no history accompanied this specimen.

Both contact and projection methods of microradiography were used to study the sections. In the former case a Matchlet type AEG 50 X-ray tube (1 mm Be filter) was used in conjunction with fine grain Lippman film[4]. The ground tooth sections were placed in direct contact with the photographic emulsion and exposures (60 min) made at 5 kV 21 mA, subsequent enlargement of the plate image being obtained optically. The kilovoltage and filter (Be) here mentioned provided an operating wavelength of the order of 2·4 to 4 Å, this region being selected since the calcium K edge which occurs at 3·07 Å falls within this range. Within this wavelength region the organic components exhibit practically no absorption, hence the micrographs ob-

[1] H. Röckert, Exper. *13*, 142 (1957).

[2] H. Röckert, *Göteborg Tandläkare Sällskaps Årsbok 1955* (Göteborg Universitet, Sverige), p. 55.

[3] R. L. de C. H. Saunders, *Cambridge Symposium on X-ray Microscopy and Microradiography* (Academic Press, New York 1956).

[4] A. Engström and L. Wegstedt, Acta radiol. *35*, 345 (1951).

tained showed the calcium distribution within the specimen at optimum contrast.

Tooth sections were also studied by the projection method using the Cosslett-Nixon X-ray microscope[5]. In projection microradiography a point source (1 μ or less) of X-rays is used, and the specimen and photographic plate are separated, hence an initial geometrical enlargement ($\times$ 200 or more) is easily obtained, followed by further photographic enlargement.

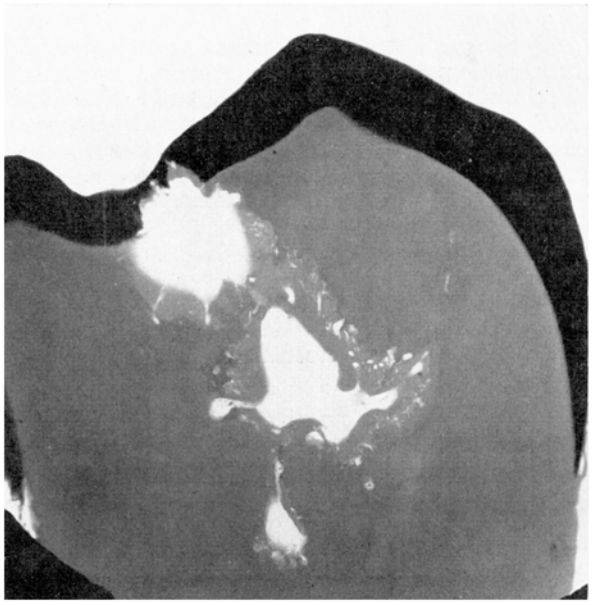

Fig. 1. – Microradiograph of ovarian dermoid tooth to show general features. Note the irregular pulp cavity and less mineralised juxta-pulpal zone (contact print $\times$ 10).

The structural features so demonstrated were in general similar to those of the human permanent dentition, in that enamel, dentine, pulp cavity, root canal and cementum were all present (Fig. 1). The enamel image revealed no peculiarities, excepting that a suggestion of Retzius lines (also confirmed histologically) was observed in a small area of the cervical enamel in one instance, and the presence of a large cavity below the coronal enamel of another tooth (Fig. 1). (Better enamel detail could have been obtained with thinner sections but the limited amount of material provoked caution during the grinding process.) This cavity resembled a carious lesion although the state of the surrounding enamel and dentine and mineral distribution therein was inconclusive.

The dentine exhibited the usual radiation of the dentinal tubules. This radiation was formed by well marked dentinal tubules. The dentine was characterised by numerous interglobular spaces and concomitant patchy or irregular mineralisation, both of which were most evident in the region adjacent to the pulp cavity (Fig. 2). Another feature was a distortion of the odontogenetic zone with an apparent broadening (Fig. 3) of the hypomineralised juxta-pulpal zone which normally surrounds the pulp cavity (Fig. 4). The dentinal surface facing on the pulp was strikingly irregular owing to the presence of large vascular incursions; these formed a marked contrast with the minor crenellations occupied by the subdentinal capillary plexus as seen in an oral tooth. The spacious pulp cavity was occupied by large vessels that lay in the long-axis of the dermoid tooth. A localised deposition of cementum was evident upon the root and showed no evidence of rhythmical mineralisation.

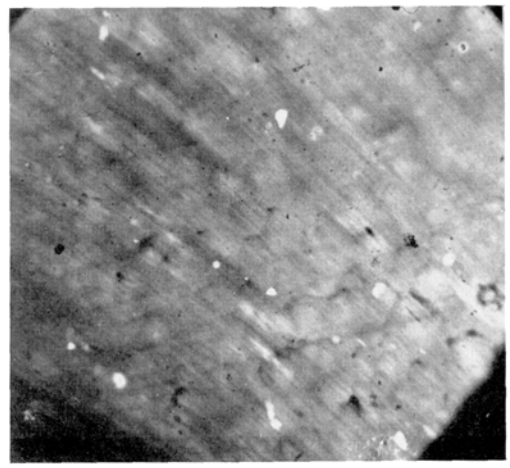

Fig. 2. – Microradiograph of dermoid tooth section showing interglobular dentine and dentinal tubules (64 $\times$). White areas correspond to high calcium content.

The development of caries in dermoid teeth has been reported[6] in view of its possible bearing on the etiology of dental caries through locally acting exogenous agents. No attention, however, has been paid to the nature and possible effect of the intracystic fluids on dermoid teeth, apart from the fact that ovarian cysts may become infected and thereby induce erosion cavities.

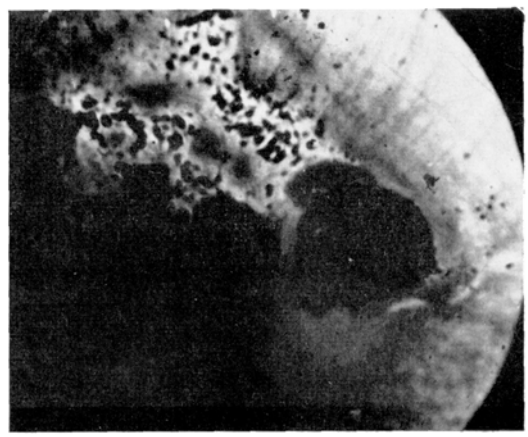

Fig. 3. – Same specimen as previous figure showing juxta-pulpal region.

A deeply placed cavity was here discovered within the enamel and dentine of a dermoid tooth section. Although suggestive of a carious lesion the microradiographic appearances could not be regarded as characteristic, and unfortunately there was insufficient material for further histological study. The cavity here seen might have been part of an irregular pulp cavity.

[5] V. E. COSSLETT and W. C. NIXON, Proc. roy. Soc. London [B] *140*, 422 (1952).

[6] W. D. MILLER, Dtsch. zahnärztl. Wschr. *1906*, 388. – M. E. POTHERAT, Bull. Soc. Chir. Paris *46*, 930 (1920). – A. WEDL, *Atlas der Pathologie der Zähne* (A. Felix, Leipzig 1903).

The structure of the sectioned dentine as revealed microradiographically (Fig. 2) bears a striking resemblance to the microphotograph of imperfectly formed dentine published by ECCLES and HOPEWELL-SMITH[7] as a feature of dermoid teeth (their Fig. 6). These authors regarded 'the abundance of interglobular spaces' as proof of dentine of an incompletely developed character.

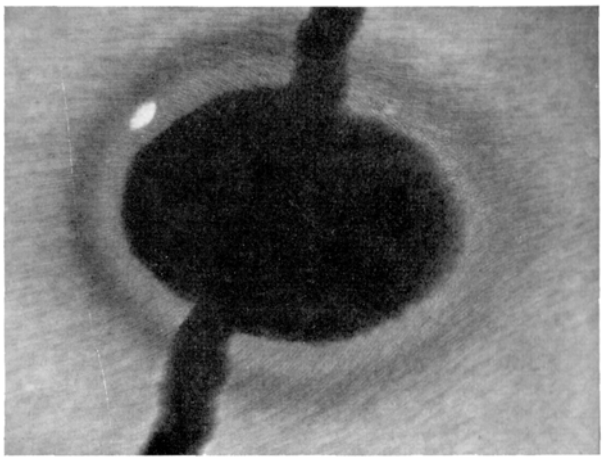

Fig. 4. – Microradiograph of normal oral tooth showing hypomineralised zone of the dentine surrounding pulp (64 ×).

Microradiography suggests that these appearances are due to a chemical (mineralisation) disturbance arising out of vascular (pulpal) abnormality. The juxta-pulpal zone, and vascular surface of the pulp cavity, in dermoid teeth poses the question as to whether the interglobular dentine is a degenerative phenomenon or is formed before the final stage.

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Zusammenfassung

Die Struktur von Zähnen aus ovarialen Dermoidzysten wurde mikroradiographisch mit Röntgenstrahlen untersucht, deren Wellenlängen dem eng begrenzten Absorptionsmaximum von Calcium entsprachen. Dabei zeigten sich im Dentin viele interglobuläre Räume, eine Erweiterung der hypokalzifizierten juxtapulpalen Zone und eine unregelmässige Oberfläche der Pulpa, die auf grossen, vaskulären Ausbuchtungen beruhte. Es wird angenommen, dass diese Erscheinungen auf einer durch die vaskuläre Abnormalität der Pulpa bedingten Störung der Mineralisation beruhen.

[7] W. Mc A. ECCLES and A. HOPEWELL-SMITH, Proc. roy. Soc. Med. (odont. Sect.) *5*, 123 (1912).

Effect of Riboflavin and Nicotinic Acid on Fat Formation by *Penicillium lilacinum* Thom.

The specific effects of addition of riboflavin and of nicotinic acid to cultures of *Fusarium* spp., on fat formation in these moulds have been studied by NORD, FIORE, KREITMAN, and WEISS[1]. In the case of *Fusarium lini* increase in the iodine value of the fat was the most notable effect observed. Work in this laboratory[2] has shown that the mould *Penicillium lilacinum* can give high yields of a solid fat of very low free acidity and having an iodine value (I.V.) of about 60.

Table I. – Effect of Riboflavin

Vitamin mg/l	Sugar taken up g/100 ml	Dry felt g/100 ml	Fat g/100 ml	Fat g/100 g of dry felt	Fat g/100 g of sugar utilised	I. V.
0	16·28	4·95	2·38	48·13	14·62	59·41
0·1	16·19	4·90	2·36	48·23	14·57	56·20
1·0	15·75	5·05	2·71	49·93	17·20	61·72
2·5	13·97	4·63	2·18	47·13	15·60	67·11

The value of this fat for certain purposes would be enhanced if its iodine value could be raised. To ascertain whether this could be effected as in the case of *F. lini* additions of riboflavin and of nicotinic acid, respectively, were made to surface cultures of *P. lilacinum* which were grown from spores in a defined medium. This medium was made up with distilled water and contained (g/100 ml): Sucrose, 17; $NaNO_3$, 0·64; $NaH_2PO_4 \cdot 2\,H_2O$, 0·73; K_2SO_4, 0·011; $MgSO_4 \cdot 7\,H_2O$, 0·5; $ZnSO_4 \cdot 7\,H_2O$, 0·05; $FeCl_3 \cdot 6\,H_2O$, 0·016. The pH value was adjusted with sodium hydroxide to 6·8. The medium in portions each of 25 ml was dispensed in 100 ml conical flasks which, after sterilisation and inoculation were incubated at 25°.

Table II. Effect of Nicotinic Acid

Vitamin mg/l	Sugar taken up g/100 ml	Dry felt g/100 ml	Fat g/100 ml	Fat g/100 g of dry felt	Fat g/100 g of sugar utilised	I. V.
0	15·49	4·68	2·26	48·23	13·93	61·65
0·1	15·45	4·78	2·28	48·50	14·75	61·53
1·0	15·06	4·99	2·34	46·93	15·54	63·16
2·5	12·72	4·44	1·89	42·70	14·86	68·44

After 5 days, when complete surface mats had been formed, the vitamins were added at concentrations: 0·1, 1 and 2·5 mg/l, respectively. The vitamin solution was added aseptically beneath the fungal mats. Incubation was continued and quintuplicate sets of flasks were withdrawn after 14 days from the time of inoculation for estimation of residual sugar, dry weight of felt, fat content and the iodine value of the fat.

Results are given in Table I and Table II.

With either vitamin at a concentration of 1 mg/l the quantity of sugar taken up was lower and the dry weight of mycelium produced was very slightly higher than in the control. The rate of fat formation was appreciably raised by riboflavin but not by nicotinic acid, with slight increase in the iodine value in both cases. With 2·5 mg/l, there was suppression in rate of sugar uptake but the rate of growth was not suppressed to the

[1] F. F. NORD, J. V. FIORE, G. KREITMAN, and S. WEISS, Arch. Biochem. *23*, 480 (1949).

[2] J. SINGH, SHAH SUDHA, and T. K. WALKER, Biochem. J. *62*, 222 (1956).