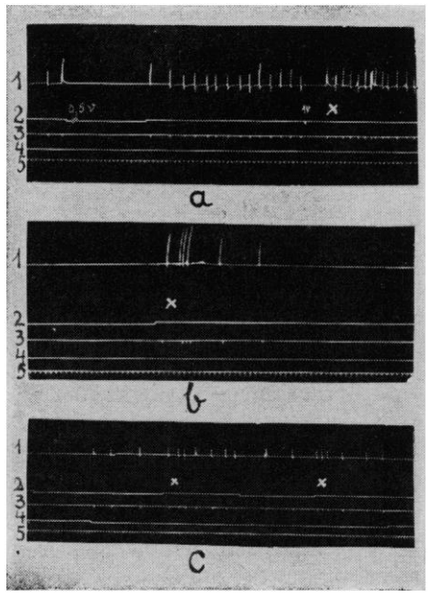

Fig. 2. Kimograms of experiments with goat No. 16 (*a*), No. 15 (*b*), and No. 14 (*c*). 1, conditioned reaction; 2, electrical stimulation of medial part of the hypothalamus ("inhibitory" stimulation); 3, food giving; 4, electrical stimulation of the lateral hypothalamus ("alimentary" stimulation); 5, time (5 seconds); *x*, moment of increase or reappearance of reaction after switching off the "inhibitory" stimulation.

effect on the act of eating as well as on the alimentary instrumental conditioned reflexes. Moreover, a noteworthy "off effect" was observed, which may be considered as a kind of rebound phenomenon. It should be stressed that this latter was present only at "inhibitory" points; it was not observed at those points where the stimulation evoked defensive reactions.

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Stimulation of Postirradiation Recovery of Cells by Cutting

Abstract. X-rays and ultraviolet radiations delay regeneration and division of *Blepharisma undulans*. Irradiated blepharisma which have not been cut divide once or twice fairly soon after the controls, then they cease dividing for a period of time (stasis) which may last for many hours or even days. Once they recover from stasis they divide at a rate comparable to controls. Cut, irradiated blepharisma, on the other hand, having to replace lost parts, start to divide later than the uncut irradiated individuals, but little if any stasis occurs. As a consequence, although irradiated with the same dosage, cut individuals recover a normal rate of division sooner than uncut ones.

In the course of studies on the effects of x-rays and ultraviolet radiations on the regeneration of *Blepharisma undulans* it was noted that individuals which had been cut just before or after irradiation appeared to divide faster than uncut irradiated individuals, inasmuch as after a lapse of time more were present in cultures from cut, irradiated individuals than in cultures from uncut, irradiated ones (*1*).

To determine whether, by itself, amputation of part of a protozoan stimulates division of the cell, the division rate of blepharisma from which the hypostome had been removed was determined. The results show that the operation does not stimulate division, rather it delays division by 8 to 12 hours; that is, by about the time it takes for an individual to reconstitute the lost oral structures necessary for feeding (5.5 hours) plus the time required to rebuild the mass of protoplasm removed (3 to 7 hours). Regeneration occurs at the expense of nutrients stored in the cell and is completed even in the absence of external food sources. When these internal stores are reduced by several days of starvation preceding cutting, regeneration takes several hours longer than in unstarved individuals, indicating that it is now more difficult to mobilize the materials required for regeneration. Once division starts after cutting, it goes on at the same rate as in uncut controls (Fig. 1).

A study of the postregeneration division of blepharisma showed that the divisions which immediately follow irradiation are delayed in both cut and uncut irradiated individuals. However, the uncut blepharisma exposed to substantial doses of either x-rays or ultraviolet radiations divide once or twice, then stop dividing for a period (stasis) which may last for many hours or even days (Fig. 1). Blepharisma cut after irradiation usually show little or no stasis. Therefore, even if the first few divisions of cut irradiated individuals are delayed as compared to uncut irradiated ones, they soon catch up with and then surpass them (Fig. 1).

This is most clearly shown in Table 1, which summarizes the differences in generation time for the first and third divisions in cut and uncut individuals. For controls (unirradiated) this is about the same for both divisions. For the irradiated blepharisma one might expect the same value as for the controls if both cut and uncut individuals were equally affected by the radiations and cutting did not affect their sensitivity. Actually the difference in generation time for the first division is greater for cut and uncut irradiated animals than for the two controls, suggesting initial compounding of the damage resulting from radiation and cutting. Much more striking is the subsequent reversal of the relative positions of cut and uncut individuals, for with few exceptions, by the third division after irradiation, the progeny of cut, irradiated blepharisma are well ahead of the uncut, irradiated ones, as indicated by the negative values.

The upshot of these experiments (*2*) is that in some way cutting seems to enable the animals to bypass the reactions which cause stasis. Kimball *et al.* (*3*) postulate that division delay in ciliates, and possibly in all cells, consists of at least two phases: (i) retardation of the first and sometimes the second postirradiation division, from which the cell soon recovers, and (ii) a long but not permanent cessation of division (stasis). The first phase of division delay they consider to result from an effect of the radiations on the mitotic apparatus; the second phase, from failure to synthesize cell materials. When the synthetic apparatus of the cell is finally repaired, the cell once again begins to grow and divide. Once division starts, the irradiation injury has been overcome. The site of protein and protoplasmic synthesis is thought to be in the ribonucleic acid–rich microsomal component of the cytoplasm (*4*). If the microsomes are inactivated (for example, by ribonuclease), synthesis ceases until more microsomes (ribosomes) are reformed. The division delay registered as stasis after irradiation may correspond to the period of replenishment of ribonucleic acid microsomes.

Cutting blepharisma is known to induce macronuclear reorganization which has been described by Suzuki (*5*) and has been verified here for both varieties of *Blepharisma undulans* (*americanus* and *japonicus*). In the present study irradiation was observed to retard the reorganization of the macronucleus required for regeneration

of the cut cells. Macronuclear activity is induced by cutting cells either before or after irradiation; such a reorganization does not occur in uncut irradiated cells, that is, irradiation by itself does not induce macronuclear reorganization. It is therefore conceivable that the block to division in uncut irradiated cells observed as a "stasis" has its locus in the synthetic ribosomes of the cells. When macronuclear reorganization is induced by cutting, new ribosomes may be liberated into the cytoplasm of the cut animals making possible synthesis of new cytoplasmic material. The cut blepharisma, upon regeneration, therefore, grow and later divide with little or no stasis. This hypothesis should be susceptible to test with some of the cytochemical methods now available.

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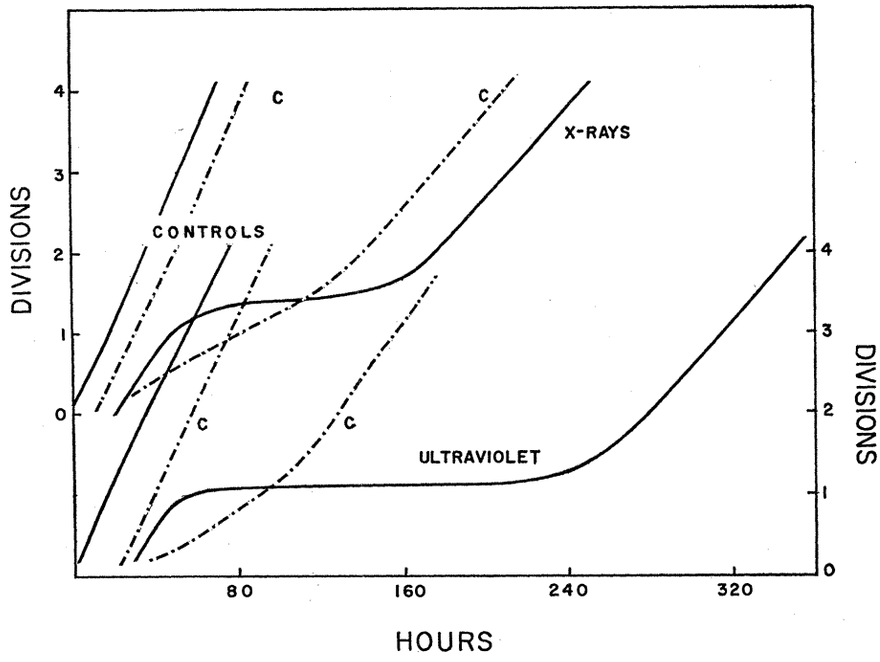

Fig. 1. Illustrative experiments showing the effects of cutting on the recovery of blepharisma from radiation injury (4600 erg/mm² of ultraviolet light at λ 2654 A and 84,600 r of 40-kv x-rays). The smoothed curves were drawn through 7 to 15 points for each experimental series. The example shown of the differential effect of ultraviolet on cut and uncut blepharisma is the most extreme observed. *C* stands for cut, hours refers to hours after treatment and isolation for tests.

Table 1. Stimulation of division of irradiated blepharisma by cutting. Part of the variability in the last four columns results from use of a nonsynchronized population, part from variation in position of the cut.

Dosage		Cut minus uncut (hours)			
		Control		Irradiated	
Ultraviolet (erg/mm²)	X-ray (r)	Div. 1	Div. 3	Div. 1	Div. 3
4025		19.0	17.5	+14.0	+5.5
4025				+14.5	−25.0
4600		26.0	29.0	+33.0	+25.0
4600		18.5	16.5	+14.5	−18.5
4600		10.0	8.5	−35.0	−26.5
4600		24.0	24.0	+46.0	−16.3
4600		18.0	20.5	+28.0	−54.5
4600*		17.0	19.5	+27.0	+1.0†
4600*‡		20.0	22.0	+37.5	−14.0
4025		14.0	18.0	+59.0	−58.0
4025‡				+90.0	+9.0†
3450		19.0	20.0	+20.0	−11.0
3450‡				+80.0	−47.0
4025		17.0	19.0	+16.0	−45.0
4025‡				+49.0	−46.0
4025		13.0	14.0	+6.0	−109.0
4025‡				+49.0	−91.0
4025		13.0	14.0	+1.0	−106.0
4025‡				+55.0	−89.0
	86,400	10.0	10.5	+17.5	−19.0
	86,400	13.0	16.0	+36.0	−34.0
	86,400	16.0	18.0	+44.0	−30.0

* Cut after irradiation; in all other ultraviolet experiments blepharisma were cut ½ to 1 hour before irradiation. † The differences became negative in the fourth division after irradiation. ‡ Refers to flashing ultraviolet. Dark periods of 0.03 to 0.05 second broke the flashes of light; otherwise continuous ultraviolet was used.

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Verification of Earth's "Pear Shape" Gravitational Harmonic

Abstract. Predictions of the orbit of the Transit 1B satellite were systematically in error until account was taken of a third-order gravitational harmonic. The amplitude deduced for this harmonic by O'Keefe from the Vanguard I orbit serves very well, even though the orbits and the methods of observation and orbit fitting for the two satellites are quite different.

From the motion of the earth satellite 1958β (Vanguard I) O'Keefe, Eckles, and Squires (*1*) recognized and evaluated the amplitude of the third-order zonal harmonic in the earth's gravitational field. This odd-order harmonic produces a north-south asymmetry in the earth's field and corresponds to a "pear shaped" figure of the earth. The existence and amplitude of this harmonic have now been confirmed by analysis of the motion of the satellite 1960γ (Transit 1B). This satellite is part of the Transit navigation system under development by the Applied Physics Laboratory of The Johns Hopkins University for the U.S. Navy and was launched by the Air Force on 13 April 1960. The confirmation of the third order harmonic is remarkable in itself, and further remarkable because the satellite orbit, the observation method, and the orbit-fitting procedures were all different from those used in the earlier study of Vanguard. It is also remarkable because data from a very short period of time, 1 month, sufficed for the confirmation.

Table 1 brings out the differences between the investigations of 1958β