merous atmospheric SO_4^{--} samples collected near industrial sites, all of which have S^{32}/S^{34} ratios in excess of 22.03, indicate that the two Japanese coal samples enriched in S^{34} are atypical. Certainly many more δ S^{34} analyses of sulfur in industrial fuels are needed.

It is interesting to note that Junge (*2*) and Eriksson (*10*), using identical data for the concentration of excess SO_4^{--} in precipitation over the United States, have suggested a decrease and an increase, respectively, of excess SO_4^{--} near the coast line. It seems apparent, therefore, that δ S^{34} studies would assist these investigators. In nonindustrial areas, however, the limited present data indicate that H_2S of biogenic origin is the major source of atmospheric SO_4^{--} (*11*).

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Photoperiodic Response of Female Fringe-Toed Lizards

Abstract. *Uma notata* females were held over the winter under 24 hours of light per day. These animals laid from two to four clutches of eggs, with 4 to 7 weeks between clutches. Clutches contained two to four eggs. Additional light is believed to be more important than heat in causing this response.

Recently Farner (*1*) reviewed the present status of photoperiodicity in the animal kingdom, and Bartholomew (*2*) reviewed photoperiodism in reptiles. Both stated that knowledge of the photoperiodic response in reptiles is extremely limited. Most of what is known concerns males, although Bartholomew (*3, 4*) studied *Xantusia vigilis* females in this regard. However, he found that ovaries in this species reacted to a much smaller degree than testes (*4*). To my knowledge, no one has reported any female reptile ovulating in response to light stimulation. Consequently, the following observations seem worthy of note.

Table 1. Egg-laying by *Uma notata* in response to light stimulation, 1960–61.

Data	Animal No. 1	Animal No. 2	Animal No. 3
Snout-vent length at 1st clutch (mm)	70	71	76
Date exposed to 24 hr of light per day	20 July	20 July	23 Nov.
1st clutch			
Date	10 Nov.	22 Nov.	24 Jan.
No. eggs	2	2	2
2nd clutch			
Date	9 Dec.	21 Dec.	26 Feb.
No. eggs	3	4	2
3rd clutch			
Date	27 Jan.	12 Feb.	
No. eggs	3	3	
4th clutch			
Date	8 Mar.		
No. eggs	3		
Autopsy date	12 June	10 Apr.	21 Mar.
Condition at autopsy			
Left ovary	6 eggs, 1 large (7.4 mm)	3 eggs, largest 1.0 mm	6 eggs, 1 large (13.7 mm)
Right ovary	6 eggs, 1 large (7.2 mm)	0 eggs	6 eggs, 1 large (12.3 mm)

Fringe-toed lizards (*Uma notata*) are abundant in the Algodones Dunes, Imperial County, California. Females lay eggs in the field from April through August, and lay from one to four eggs in a clutch (*5*). The number of clutches per individual each year is unknown, however. These animals normally hibernate beneath the sand from November to February (*5*).

On 20 July 1960, two subadult females, which had been captured 2 days earlier in the Algodones Dunes, were placed in a small terrarium (12½ by 12½ by 24 inches). A 60-watt incandescent light bulb illuminated and heated the terrarium from above, 24 hours per day. Approximately 2 inches of sand covered the bottom of the cage. Sand surface temperatures in the terrarium ranged from 26.2°C to 29.4°C, depending on the sand's location in relation to the light bulb. Surface temperatures did not vary during the period under consideration.

These animals burrowed in the sand a good deal. Thus, they were not exposed to the light for 24 hours each day. It is impossible to say how many hours of light each animal received, since this was determined by the animal's behavior.

On 10 November lizard No. 1 laid its first clutch of eggs, followed about 2 weeks later by animal No. 2 (see Table 1). Both animals possessed bright reddish-orange sides at the time of laying. This color pattern was identical with that seen in the field on adults of both sexes from May to September (*5*). The laboratory animals, at the time of laying, were about the minimum size (snout-vent length) for laying females in the field (*5*).

On 23 November lizard No. 3, which was approximately the same size, was placed in the terrarium. This female had been hibernating in an outdoor cage as part of another experiment. It did not respond to the light or warmth in any manner until 12 December. Then it began to move about and eat. By 14 December it was beginning to acquire the reddish-orange patches on the sides of the abdomen and by 3 January 1961 its sides were bright reddish-orange. It laid its first clutch of eggs 2 months after it was placed in the terrarium. Table 1 summarizes the egg-laying data for the three animals and gives an indication of ovary conditions at autopsy.

The first and second clutches were approximately 4 weeks apart in all animals. Both lizards that produced a third clutch did so about 7 weeks after they produced the second. The single fourth clutch was laid almost 6 weeks later than the third. Thus, the interval between specific successively numbered clutches was about the same for all animals, but the time between an individual's clutches was rather variable. The eggs laid by these lizards averaged 20.2 by 11.7 mm in size (range, 17.5 by 10.0 mm to 24.0 by 13.1 mm). This compares very closely to the average size of eggs found in the oviducts of newly captured females of this species (20.4 by 11.7 mm) (*5*). Some eggs from each of the captive animals were incubated artificially, but no embryos developed.

Animal No. 3 escaped from the terrarium on 21 March. It was accidentally stepped on and killed. Autopsy revealed it was nearly ready to lay again. Animal No. 2 died of unknown causes. Autopsy showed its right ovary had almost completely disappeared, and the left ovary contained a few very small ova. This led me to think that perhaps females of this species hatch with a given number of primordial ova in the ovaries. When these have been ovulated, the animal becomes reproductively inactive. This idea was supported by the fact that animal No. 1, after laying a fourth clutch in March, stopped laying. It still retained its breeding colors and appeared perfectly healthy, however.

This hypothesis proved incorrect when No. 1 was autopsied 3 months after it laid its last clutch. It possessed as many eggs in each ovary as No. 3 had at death, although No. 1 laid nearly three times as many eggs as No. 3 (see Table 1). One egg in each ovary was quite enlarged, but neither would have been ready to lay for some time.

At present it is impossible to say how much of this response was due to light and how much to heat. Bartholomew (*3, 4*) found that light is more important than heat in producing a reproductive reaction in *Xantusia vigilis*. Probably a similar situation exists in this case, since the surface temperatures to which these animals were exposed are only slightly above the minimum required for their normal activity. When these animals burrowed in the sand they reduced their environmental temperatures still further.

They could also reduce the amount of light received simply by burrowing in the sand. However, the environmental temperatures of the cage never went above the maximum these lizards could tolerate. Therefore they were not forced to burrow under the sand by extreme temperatures, as they normally are in their natural surroundings. Consequently, they tended to stay on the surface longer than they usually do in the field, and thus were exposed to light for relatively long periods (*6*).

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Interaction between Riboflavin and Rutin

Abstract. Riboflavin-5′-phosphate forms a charge transfer complex with rutin at neutral *p*H in the same manner as it forms one with tryptophan or serotonin, when the system is observed by quantitative spectrophotometry.

Isenberg and Szent-Györgyi (*1*) reported that a strong charge transfer complex of riboflavin-5′-phosphate (RFP) can be produced at neutral *p*H by simple addition of some indoles (for example, tryptophan and serotonin). During studies of the interaction between biologically active natural substances, Nayatani and Yagi (*2*) observed that rutin, a representative flavonoid pigment, had some inhibitory effect upon photolysis of riboflavin. It is possible that a complex can be formed between rutin and riboflavin and that this complex plays some role in the stabilization mentioned above. We report evidence of interaction between RFP and rutin; we used the method of Isenberg and Szent-Györgyi (*1*).

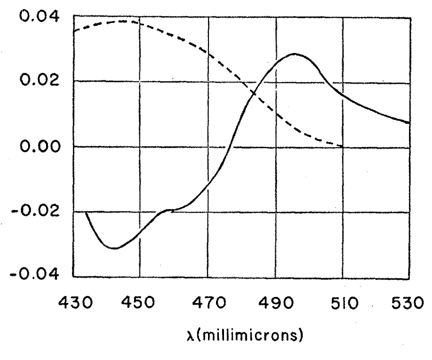

Fig. 1. Absorption curve of RFP-rutin complex in phosphate buffer (*p*H 7.0) at room temperature (solid line). The RFP concentration is $5 \times 10^{-5}M$ in both the sample and the reference cell; the rutin concentration in the sample cell is $2 \times 10^{-4}M$. The measured extinction is corrected for the rutin absorption. (Dashed line) Absorption curve of a control solution of RFP ($4 \times 10^{-6}M$).

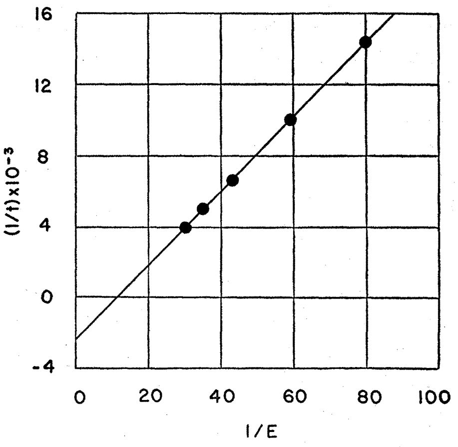

Fig. 2. Plot of the inverse of the rutin concentration ($1/t$) versus the inverse of the extinction of the complex ($1/E$). The RFP concentration is $5 \times 10^{-5}M$ in both cells.

Upon balancing $5 \times 10^{-5}M$ RFP with varying concentrations of rutin against $5 \times 10^{-5}M$ RFP, all in phosphate buffer of *p*H 7.0, a peak was obtained at 495 mμ, while a control solution of RFP showed a peak at 445 mμ (Fig. 1). In the 400- to 530-mμ region, the measured extinction of the complex was corrected for the considerable absorption of rutin. From the similarity of this shift to the shifts in the spectra of RFP and indoles, we concluded that a strong charge transfer complex is produced, in which a rutin molecule gives one electron to an RFP molecule.

To compare rutin's affinity with the indoles' affinity, the inverse of the dissociation constant of the complex, K, was obtained by plotting $1/E$ against $1/t$, as shown in Fig. 2. Since the intercept on the ordinate corresponds to $-K$, rutin's K equals 2400 lit./mole; K for tryptophan equals 60 and K for serotonin equals 400. It is interesting to note that rutin has much higher affinity for riboflavin than tryptophan or serotonin.

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