of the role of these pigment bodies in terms of possibly higher sensitivity than those of the dorsal skin to light of the same wave-lengths or in terms of possibly greater (if not specific) sensitivity to particular bands of the spectrum. What is contemplated is an additional behavioural study of the responsiveness of this species to various parts of the spectrum as well as concomitant spectral analyses of the extracted pigments before and after exposure to each of several bands of the light spectrum.

This work was carried out at the Woods Hole Marine Biological Laboratory Department of Physiology Laboratories; I am indebted to Dr. Daniel Mazia for making such facilities available for this study and to Dr. George Wald of Cornell University for his valuable suggestions concerning the chemical aspects of the work.

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Failure of Enforced Hibernation to inhibit Breeding in the Frog (*Rana temporaria*)

IT is well known that the frog (*Rana temporaria*) is extremely tolerant of cold, and may continue to breed when ice covers or encrusts the sides of the ponds. Warmth, or a small transitory rise in temperature, however, may be necessary for breeding to be initiated.

Dr. M. Smith[1] suggests that the variability in time of spawning (apart from temperature) may be due to the phosphate content of the water and to the availability or otherwise of food for the tadpoles. The amount and the intensity of light are also thought to be important.

In view of these accepted facts, it seems worth while recording the following.

A group of male and female frogs, captured in East Anglia in late September 1954, were subjected to enforced hibernation in a domestic refrigerator early in October of the same year.

The thermostat in the refrigerator was set so that the temperature was maintained at 38° F. A maximum and minimum thermometer was put into the refrigerator and the temperature checked twice each day.

The animals were stored in a shallow enamel tray containing 1½ in. of tap water and covered by a piece of hardboard drilled with several ½-in. holes. The water in the tray was changed on alternate days. There was no pilot light in this particular refrigerator.

In mid-May 1955, 7½ months after enforced hibernation had started, amplexus occurred in four pairs of animals and spawn was laid.

Spawn continued to be laid at intervals until early July. During this time, however, the animals were not always in amplexus. The spawn was removed from the refrigerator and put into shallow trays; some contained tap water and one contained rain water. The spawn in the rain water developed and the spawn in the tap water did not. By August 1955 the froglets from this spawn were approximately 1½ cm. long and beginning to take adult frog laboratory food.

When the adult frogs spawned it is estimated that they had been exposed to light of average indoor intensity for half a minute on alternate days for 7½ months, and warmth for the same period. They had, however, been exposed to cold tap water also on alternate days. Due to the large surface area, the water would probably only take 15–30 min. to attain the temperature of the refrigerator, that is, 38° F. It is probable that the phosphate content of the water varied little, and certainly there was no food available either for the adult frogs or for any potential tadpoles. It is noteworthy that not all the female animals spawned, and that the onset of breeding was substantially delayed in the others.

It is possible, and indeed probable, that there was a gradual build-up of the hormones necessary for breeding to occur; but it must be generally agreed that the external stimuli usually considered necessary for this to occur were minimal.

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Status of *Protobatrachus massinoti*

THE history of the Amphibia Salientia can readily be traced back to the Jurassic when it appears that, skeletally at least, they were already typical, modern Anura. The pre-Jurassic history of frogs, however, was completely unknown until 1937 when Piveteau[1] described *Protobatrachus massinoti* from the lower Trias of Madagascar. To accommodate *Protobatrachus*, Piveteau defined a new order, the Proanura, differing from the Anura chiefly in possessing a tail but no urostyle and with the tibia and fibula, radius and ulna, unfused.

In excluding *Protobatrachus* from the Anura, Piveteau strongly emphasized that no analogy exists between the tail of modern frog tadpoles and the 'true' tail of *Protobatrachus* since, in the former, no vertebræ develop but only the notochord with its sheaths and enveloping skeletogenous layer. In a recent survey of anuran larvæ, however, I have examined tadpoles of the pelobatid *Megophrys major* and found that, from early larval stage, they possess about seventeen ossified caudal vertebræ—a condition that, so far as I am aware, has not hitherto been described for any other anuran larva. In the light of this discovery it seemed pertinent to re-examine Piveteau's statement and the status of *Protobatrachus*.

If *Protobatrachus* is regarded as an adult form two problems of functional morphology are posed. First, the animal possesses ilia, femora, tibiæ and fibulæ which, although relatively not as elongated as in the adults of modern frogs, are, nevertheless, clearly salientian adaptations and, consequently, a sacral articulation would be expected. But no sacrum appears to be present. Two vertebræ with backwardly directed ribs lie between the iliac arms, but they are quite free of the pelvic girdle; while, mesial to the heads of the ilia, where articulation normally occurs, the single vertebra present is unexpanded and unspecialized. How, then, can the salientian trends so clearly shown in the hind limbs and girdle, and which are so essentially concerned with transmission of