now in progress. While the results of this investigation do not establish the identity of the chemical substance responsible for the conditioned behavior of the regenerated animal, they appear entirely compatible with the assumption that this substance may be RNA. Further histological and biochemical explorations of this preparation are needed to evaluate this possibility adequately (*14*).

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Latent Period of Relaxation

Abstract. The latent period of relaxation of molluscan myocardium due to anodal current is much longer than that of contraction. Although the rate and the grade of relaxation are intimately related to both the stimulus condition and the muscle tension, the latent period of relaxation remains constant, except when the temperature of the bathing fluid is changed.

It is well known that a muscle exerts its tension after a short latent period. Hill (*1*) stated that this latent period of a muscle after stimulation is an extremely sensitive indicator of slack between the fixed support at one end of the muscle and the mechano-transducer at the other. Sandow (*2*) considered the latent period of a muscle to be intimately related to chemical reactions prior to muscle contraction. There appears to be much information concerning the latency before muscle contraction, but we do not have much information about the latent period of relaxation. The probable reason for this lack of information is that we have not been able to induce relaxation by easily controlled electrical techniques.

It has been demonstrated that relaxation can be produced by applying an electrical stimulus to a tonic smooth muscle preparation (*3*) and to a skeletal muscle in a state of contracture (*4*). The relaxation is probably due to the electrotonic effect of the current applied on the mechanical system. Recently we have observed in oyster myocardium that relaxation can be produced by anodal stimulus and contraction by cathodal stimulus (*5*).

In the present study, we isolated an oyster heart in an artificial sea-water bath; the atria were ligated and connected to a bonded strain gauge. The other end of the heart was left joined to the aorta in order to record the isometric tension. A 500-μ silver–silver chloride electrode rested on an atrium and the other end was connected to an isolator circuit of the electronic stimulator. A large wick electrode in the sea-water bath served as the source of polarity and as the stimulating electrode. Because the current-applying electrodes were the surface electrodes, the passage of the current through the membrane is not simple and is difficult to analyze, but the effect of reversal of polarity is very definite, as is demonstrated by the illustration.

A typical example of cathodal contraction and anodal relaxation is shown in Fig. 1*A*, where the effects of stimulation during the relaxation phase of a heart cycle are shown superimposed on a rhythmical heart beat. In Fig. 1, *A-1* represents the normal cycle and *A-2* and *A-3* represent cathodal and anodal stimulation, respectively. The latency of cathodal contraction is estimated to be 90 msec, whereas the anodal relaxation latency is 300 msec. The difference in latency is more than threefold. The difference in latency of relaxation and contraction can be demonstrated even more clearly when the myocardium is arrested in a state of tonic contraction by means of potassium chloride depolarization (Fig. 1*B*). In 58 instances of anodal polarization the latent period of relaxation averages 291 msec; this value is very similar to the latent period of relaxation from spontaneous contraction. We believe that the latent period for relaxation is independent of the tonic state of the myocardium, and independent of the intensity of stimulus, although the speed and the grade of relaxation are both intimately related to the strength of stimulus.

The administration of narcotics, such as urethane and ether, or metabolic inhibitors such as monoiodoacetic acid and 2,4-dinitrophenol, causes a remarkable inhibition of relaxation, but the latent period remains constant before and after an administration of these drugs. The temperature change of the external fluid appears to be the only condition that will vary the latent period. The higher the external temperature, the shorter the latent period. The average temperature coefficient is 1.98. The latent period of relaxation appears to have some relation to the chemical process. This relationship is supported by the observation of Weber (*6*) who suggested that the adenosine triphosphate splitting is a prerequisite for contraction, and that the relaxation phase of muscle is not an active process, but simply the end of the adenosine triphosphate splitting.

Still another theory for the explanation of the latent period is that there

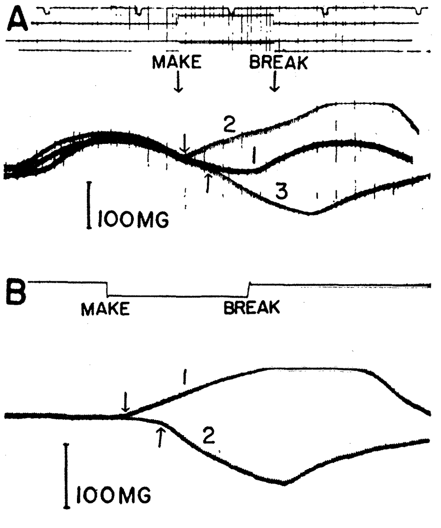

Fig. 1. Tension curves showing latent periods of contraction and of relaxation. Stimulation was applied at the stimulus mark; duration, 1 sec. Time signal, 1 sec. *A*, Latent periods in a spontaneously contracting muscle: 1) control, 2) cathodal contraction, 3) anodal relaxation. *B*, Latent periods in a tonic muscle with 1.25-percent KCl solution applied: 1) cathodal contraction, 2) anodal relaxation. A downward arrow indicates the point at which contraction starts and an upward arrow shows the point at which relaxation starts.

may be a change of electrical charge on the cell membrane during cathodal and anodal stimulation. The cause of this electrotonically induced relaxation awaits further study, but this experiment presents some indication of the effect of electrochemical processes in muscle relaxation (*7, 8*).

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Environmental Significance of Palynomorphs from Lower Eocene Sediments of Arkansas

Abstract. Spores and pollen present in sediments of the lower Eocene Wilcox group in south-central Arkansas are mixed temperate and tropical genera. The source area is postulated to have been temperate highlands adjacent to a tropical coastal plain. A similar interpretation based on plant megafossils has been made. Hystrichosphaerids and dinoflagellates found in the sediments suggest a depositional environment of brackish water.

One of the most extensively studied fossil floras is that present in the sediments of the Wilcox group, lower Eocene in age, in the Gulf Coastal Plain. This flora has been studied by paleobotanists including Lesquereux (*1*), Berry (*2, 3*), Ball (*4*), and Brown (*5*). Berry conducted the most extensive study, describing 543 species from 180 genera and 82 families. After considering the corrections and additions to Berry's work, Sharp (*6*) listed 137 genera from the Wilcox flora ". . . whose taxonomic position is known with more or less exactness."

There has been considerable speculation about the environmental significance of this lower Eocene flora. Berry (*2*) considered the flora to be tropical and noted that there were no strictly temperate genera. He speculated, however, that ". . . the Wilcox flora probably seemed to be more tropical in character than it really was." Berry also noted the absence of an accompanying brackish water fauna that he believed should have developed in the upper part of the Mississippi Embayment during the lower Eocene.

Brown (*5*) and Sharp (*6*) interpreted the Wilcox flora as being more temperate in nature than did Berry. They pointed out the presence of a number of temperate genera in the flora, including *Betula, Comptonia, Fagus, Sassafras,* and *Staphylea.*

Sharp (*6*) compared the fossil flora of the Wilcox group with the modern floras of a number of regions. He found that some 60 percent of the genera described from the Wilcox sediments still persist in the southeastern United States, the area in which Wilcox sediments were deposited. Thirty of these genera are, however, restricted to Florida. Sharp stated that approximately 53 percent of the Wilcox genera are present in the present flora of central and eastern China. He found the greatest degree of similarity between the Eocene Wilcox flora and that now present in eastern Mexico, an area of high mesas and neighboring coastal plains. Some 68 percent of the Wilcox genera are present in this area.

Two genera, *Quercus* and *Pinus*, which are important elements in the Mexican flora, had not been reported from the Wilcox sediments when Sharp conducted his study. Despite the absence of these two genera in the Wilcox flora, Sharp concluded that the environmental conditions in the Gulf Coastal Plain during the lower Eocene were essentially like those of eastern Mexico at present.

A recently completed palynological study of sediments from the Wilcox group in central Arkansas (*7*) disclosed the presence of 62 spore and pollen types, including both *Quercus* and *Pinus*. The study is based on 60 samples collected from outcrops of the Wilcox group in Pulaski and Saline counties. From this area Berry had described only 12 genera of megafossils. The pollen of *Pinus* is a common constituent of the microflora, present in amounts ranging up to 10 percent of the total forms in some samples. *Quercus* pollen is less common but is present in most of the samples that were analyzed.

The 62 spore and pollen types found in the Wilcox sediments are a mixture of temperate, subtropical, and tropical genera. These include genera such as *Carya, Engelhardtia, Myrica, Manilkara, Symplocos,* and *Anacolosa.* The environmental interpretation of a warm, humid coastal plain with adjacent highlands, such as Sharp described for eastern Mexico, is thus supported by both the megaflora and the microflora. Hystrichosphaerids and dinoflagellates are also present in small numbers in the samples. These fossil groups, considered significant of marine or brackish-water environments, support Berry's postulation that the plant remains and the enclosing sediments were deposited in a brackish-water environment.

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Hole Drilling by Octopus

Abstract. Octopus bimaculoides and *O. bimaculatus* can drill holes in the shells of their molluscan prey, through which they appear to inject a paralyzing venom.

Octopuses are found among the marine littoral fauna throughout most of the world. Because of their appearance, edibility, and behavior, they are well known to maritime peoples. It has long been known that a large part of the food of the octopus consists of shelled mollusks (*1*). The suggestion has been made that the octopus obtains this food by exerting greater force than the prey can withstand. Bartsch (*2*), writing of *Octopus vulgaris* Lam., says, "Presumably he opens a mussel by attaching some of his suckers to the two valves of the shells and then applying pressure until the valves give way." Phillips (*3*), discussing California species of octopus, states that "abalone divers tell of occasionally finding an octopus patiently exerting pressure on an abalone. The abalone eventually tires, even as an oyster gives in to a starfish. The octopus can also open mussels in this manner."

The investigation reported here was prompted by the observation that the empty shells of small abalones appear-