at least 1859, but none has focused on the activity at the sarcomere. Kühne (*6*) found that an isolated muscle floating on mercury would not uncoil after contraction. However, Kaiser (*7*) showed that a muscle would relax on mercury if it were first dipped in oil to reduce friction.

Ramsey and Street (*8*) noted that a single fiber does not elongate after contraction if it has shortened to greater than 60 percent of its resting length. They defined irreversible contraction as the delta state and postulated an alteration in the contractile elements. Length-tension measurements made before and after shortening to 60 percent of fiber length showed that excessive shortening had altered the contractile capacity of the fiber, which, in turn, affected relaxation.

A. V. Hill (*9*) has demonstrated gross differences between the resting and relaxation properties of whole muscles and those of single fibrils. Despite this finding, Hill concluded from his work on whole muscles that relaxation was not an active process, and that muscle elongation was due to elastic forces outside the contractile elements (*9*). Translation of experimental data, such as Hill's, from an intact muscle to the sarcomere is not a simple matter, since the mechanics and forces involved in a muscle are more complex than those in a single fiber, and are even more so than in the case of the sarcomeres or a single fibril. The properties of sarcomere relaxation or elongation can be observed directly, eliminating factors in the intact muscle that may obscure or alter important details of the contraction-elongation cycle. Relatively gross measurements or observations of muscle relaxation should be confirmed by direct microscopic observations of the sarcomere to determine its configuration.

In their consideration of active relaxation, Buchthal and Kaiser (*10*) cite instances in which elongation occurs and note that elastic energy may be stored in the sarcolemma or contractile elements during contraction, but they did not find an "unambiguous answer to the problem of active or passive relaxation."

Recently Podolsky and Costantin (*11*) have shown that isolated fiber segments of frog semitendinosus immersed in paraffin will contract upon the direct application of calcium. The entire segment remains contracted until the concentration of calcium is sufficiently decreased, presumably by being pumped into the sarcoplasmic reticulum. The segment then elongates and approaches the initial rest length. Before the calcium is applied, the sarcolemma is stripped from the fibers, thus eliminating it as a possible source of elastic energy for elongation.

Observations on the behavior of cardiac muscle during diastole indicate that the force needed for relaxation is within the muscle itself. Cardiac muscle is unique, for there are no tendons or antagonistic muscles to aid in elongation of its sarcomeres. However, ventricular relaxation is not entirely due to the pressure of blood flow from the auricles. During the initial phase of rapid filling in diastole, the ventricles are empty but relaxed, and the blood actually seems to be sucked into them (*12*). Ventricular relaxation and the suction effect in ventricular filling may be a gross manifestation of the elastic elongating force of the individual sarcomeres.

An intrafibrillar force of elongation seems to be present not only in fibrils of cultured myoblasts but in vertebrate striated muscle in general (*13*). Such a force could use chemical energy directly, but studies of Hill (*14*) and Cain *et al.* (*15*) indicate that contraction is the phase immediately dependent on chemical energy. Our observations favor the idea that, during shortening, elastic energy is stored in the contractile elements by distortion of bonds between the contractile elements and the structural proteins of the sarcomere. This energy is then released at the end of contraction, thus restoring the resting sarcomere length. It seems reasonable to suggest further that, since sarcomere length, that is, the overlap of thick and thin filaments, is mechanically important for the development of tension (*3*), there should be a mechanism within the sarcomere which reestablishes the optimum precontractile configuration in the extended or uncontracted fibril.

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4 April 1966

Iphita limbata Stal.: Components of Neurosecretory Material

Abstract. *The median neurosecretory cells of the pars intercerebralis of* Iphita limbata *seem to release two demonstrable components, probably representing allatotropin to the corpus allatum and myotropin to the aortic neurohemal site.*

The neurosecretory system is an important endocrine center in *Iphita limbata* Stal. (Pyrrhocoridae, Hemiptera) (*1–3*). Nayar's histophysiological evidence suggests that the cells of the pars intercerebralis of the brain supply neurosecretory materials to the corpus allatum, possibly stimulating the gland to exercise its gonadotropic functions in the female. In *Iphita,* oviposition is delayed until copulation, which usually occupies about 3 weeks, is complete. As oviposition begins, the corpus allatum is denied its neurosecretory supply and neurosecretory colloids are discharged into the blood (*3*).

Using Humberstone's Victoria Blue

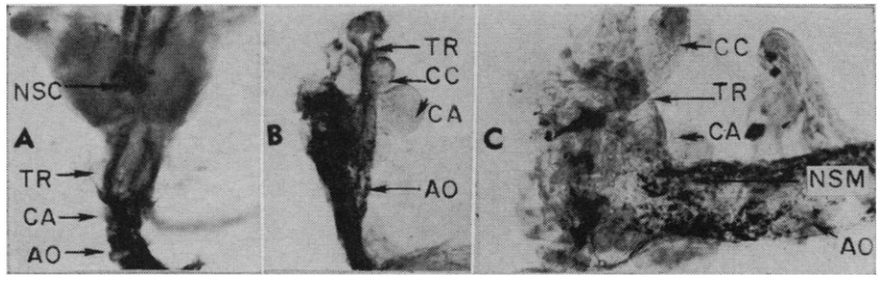

Fig. 1. *A*, Brain, retrocerebral complex, and aorta of *Iphita*; whole mount, Formol-saline, performic acid–Victoria Blue (× 25). Abbreviations as in Fig. 2. *B*, Retrocerebral complex and aorta of *Iphita*; whole mount, Formol-saline, performic acid–Victoria Blue (× 25). *C*, Retrocerebral complex of *Iphita*; whole mount, Formol-saline, performic acid–Victoria Blue (× 90).

method for staining neurosecretory materials in whole mounts (*4*), we traced axons from neurosecretory cells in the pars intercerebralis; they traverse each side of the corpus cardiacum and appear to terminate on the wall of the aorta, where the neurosecretory colloids accumulate in a typical neurohemal structure (Figs. 1 and 2). When eggs are developing in copulating females, there are large accumulations of stainable neurosecretory materials in this tract and the aortic wall. In ovipositing females, however, these neurosecretory colloids are clearly depleted, depletion suggesting a release of stored neurosecretory products. Notably, moreover, this technique reveals no stainable colloid in the allatal nerve or in the corpus allatum at any stage of egg development or oviposition.

Our technique, a modification of the method of Adams and Sloper (*5*), reveals sites of resulting cysteic acid. Thus one may presume that the neurosecretory material that finds its way to the wall of the aorta in *Iphita* contains cystine or cysteine, as does the neurosecretory material of vertebrates. The neurosecretory supply to the corpus allatum (*2*) must involve a different neurosecretory material, because no cysteic acid could be demonstrated. Thus we tentatively suggest that there are at least two neurosecretory components involved in the reproductive cycle in *Iphita*: One, not demonstrable by Humberstone's technique but discernible by the usual staining methods, goes to the corpus allatum and is a possible allatotropin; the other, containing cystine or cysteine, is released from a neurohemal structure in the wall of the aorta and is a probable myotropin. Both types of neurosecretion are stainable by the usual techniques.

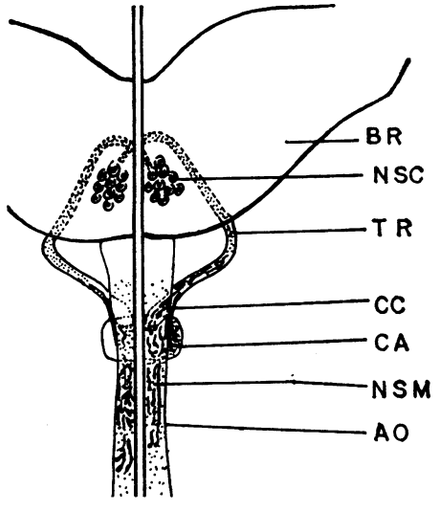

Fig. 2. Composite diagram representing preparation stained with Gomori's chrome-hematoxylin-phloxin on the right side and with performic acid–Victoria Blue preparation on the left. On the left appear the median neurosecretory cells (*NSC*), and the neurosecretory tract (*TR*) leading directly to the aorta (*AO*) forming the neurohemal organ. Corpus cardiacum (*CC*) and corpus allatum (*CA*) are not stained. On the right is seen the tract leading to the heart (as on the left), but neurosecretory material (*NSM*) is also shown in the corpus cardiacum and corpus allatum. *BR*, brain.

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21 February 1966

Multicapillary Mixer of Solutions

Abstract. *A mixer made from a bundle of glass tubules can mix two solutions within 30 microseconds, with a total-solution flow rate of 1.33 milliliters per second. One solution passes through the interstices of the bundle; the other moves through the lumens of the tubes.*

Studies of the time course of a reaction following mixture of the components require complete mixing within a period short in relation to the duration of the reaction. We now describe a device that produces a paraxial array of alternating jets of reactants that appear to mix the streams intimately within a short distance in a plane normal to the flow axis. Kletenik's (*1*) similar approach used alternating thin sheets of reactants.

The mixer is made by fusing a bundle of thin-wall glass tubules, each about 2 mm in outside diameter, into a tube of about 10-mm outside diameter that serves as a jacket; the bundle is then pulled to a tip about 2 mm in diameter within a distance of about 1 cm (Fig. 1). When cut, the narrow section presents a smooth fracture plane through all the glass tubes. A side tube to the jacket permits fluid to be pumped around the tubules to reach the tip through the interstices; the spaces between the tubules are sealed by fusion upstream of the side tube, which separates the two fluid paths. Fluid entering this end reaches the tip by flowing inside the tubes; fluid entering the side tube reaches the tip by flowing through the interstices. After a little practice, the assembly can be made in about 20 minutes exclusive of time for annealing.

The size of capillaries obtained depends primarily on the amount of heat applied before the tubes are drawn out. When these units are properly made, the drawn end will have the same proportions as the original dimensions. The ratio of wall thickness to intra- and extra-capillary space remains the same, but on a reduced scale. Diameters of individual capillaries have varied from 25 to 250 μ, depending on the construction of the mixer. The ratio of the cross sections of the two channels can be altered by changing: (i) the thickness of the capillary wall (increase in wall thickness also increases dead space); (ii) the shape of the capillary; or (iii) the number and size of the capillaries within the outer glass jacket.