greater than the critical pressure either stabilized the heart rate at a high level or produced arrhythmia. 5. Variation in temperature and ionic composition of Ringer fluid or pH did not produce a significant change in stretch-acceleration response.

Discussion. The electrophysiological studies were conducted to verify the origin and nature of pressure tachycardia, and it was observed that this was due to increased impulse generation at the pacemaker (Pathak[4]). In view of the experimental evidence referred to above, and in view of the fact that isolated frog hearts suspended in Ringers solution and mammalian hearts perfused through coronary artery are activated and stimulated when the pacemaking chamber is distended additionaly, it is concluded that stretch of pacemaker and muscular tissue produced by the venous return is the fundamental stimulus for intrinsic autoregulation of heart rate as well as force without involvement of the superimposed neurohumoral influences. The intimate mechanism of action of stretch itself could, however, be different in the pacemaker and in the contractile musculature. Mechanical stretch is, therefore, a basic biological stimulus for the rhythmicity and contractility of the heart and it links the venous circulatory load with cardiac output (work performance) in a positive feed-back manner. The importance of stretch as an intrinsic autoregulatory mechanism for the inotropic response implied in Frank Starling's law of heart and its application in the body is well recognized[8]. But because of the subtle nature of the action of stretch on the pacemaker, and because of the erroneaus concept of the 'Bainbridge reflex' (Pathak[6,7]), the role of stretch in the autoregulation of chronotropic response has not received due recognition. With this point in view, the relative role of stretch and superimposed neurohumoral influences is diagrammatically highlighted in Figure 2. The common property of stretch sensitiveness of chronotropic and inotropic responses makes the heart an unique autoregulating pump.

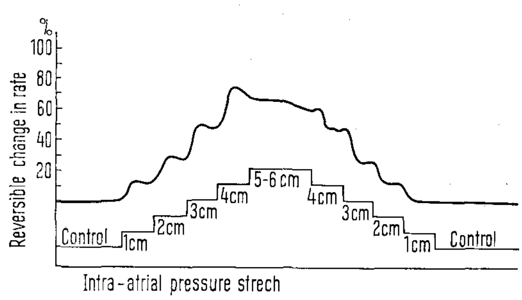

Fig. 1. Pattern of Stretch-acceleration response due to raised sinus or right atrial pressure. Note the sudden increase in the heart rate to a peak value followed by tendency to stabilization at a slightly lower level during the maintenance of each increment of pressure from below 1 cm up to 4 cm water pressure, at which level the heart rate tended to assume a plateau. The plateau was either maintained or the heart rate fell below the plateau level between 5 to 6 cm. Reversing the steps of pressure changes reversed the heart rate back to the initial control level.

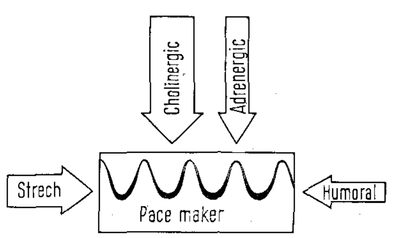

Fig. 2. Main physiological factors modulating pacemaker activity and their relative intensity as indicated by the thickness of arrows.

Résumé. L'étirement mécanique est une force motrice fondamentale pour l'autorégulation intrinsèque du rhythme du cœur en modifiant l'activité du «pacemaker» de la même manière que la distension du myocarde influe sur le réponse inotropique. L'étirement est un mécanisme biologique de base pour la rythmicité cardiaque et la contractilité et il met en interdépendance positive le retour veineux et le débit sanguin. La sensibilité à l'étirement est une propriété des réponses chronotropiques. Elle fait du cœur une pompe autorégulatrice unique en son genre.

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The Aorta Wall as a Storage Organ for Neurosecretory Material in Orthopteroid Insects

The corpora cardiaca and/or the aorta wall have been described as neurohaemal organs in insects. Three different conditions have been reported in previous accounts. Neurosecretory material may be stored both in the corpora cardiaca and the aorta wall, or only in the aorta wall, or only in the corpora cardiaca.

In the hemipterans *Iphita limbata*[1] and *Adelphocoris lineolatus*[2], it has been found that the A-material present in the aorta wall is released from the corpora cardiaca. Similarly in the dipteran *Calliphora erythrocephala*[3,4] neurosecretory material is stored partly in the aorta wall and partly in the corpora cardiaca. In the beetle *Aulacophora foveicollis*[5], the corpora cardiaca and the aorta wall are fused and neurosecretory material has been seen entering the latter from the former. DOGRA[6], working on 5 species of Heteroptera, however, came to the conclusion

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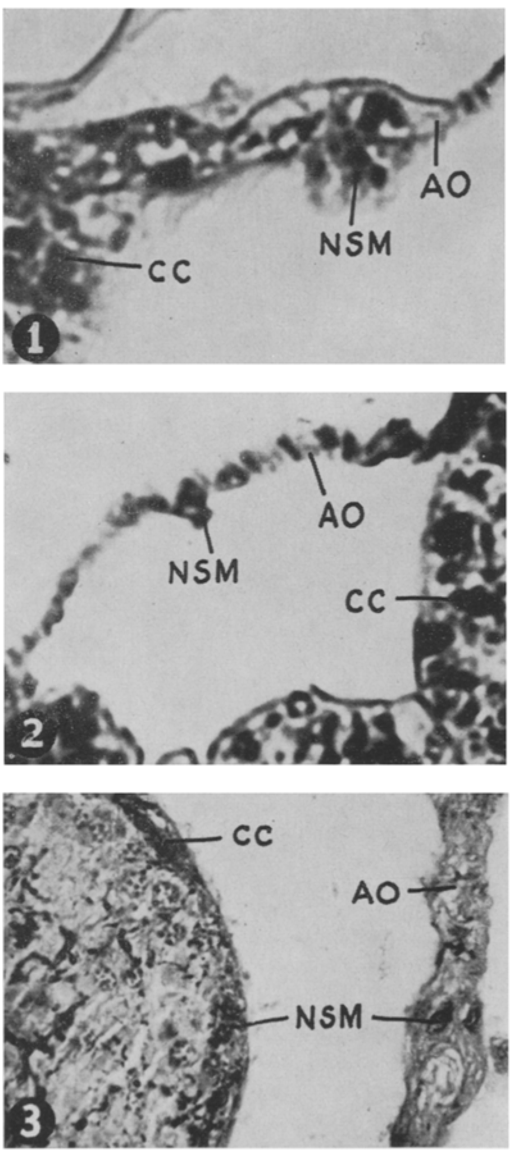
that the aorta wall, but possibly not the corpora cardiaca, is the storage and release organ for A-material. This supports an earlier report by JOHANSSON[7] that in the bug *Oncopeltus fasciatus* only the aorta wall is the storage site for neurosecretory material. SHRIVASTAVA[8], working on the pentatomid bug *Halys dentatus*, also concluded that there is no neurosecretory material in the corpora cardiaca. He traced the axons of NCC I to the aorta wall where they were found to divide extensively. Thus in the representatives of the Hemiptera, Diptera and Coleoptera so far investigated, neurosecretory material is stored both in the corpora cardiaca and aorta wall, or only in the aorta wall.

In the orthopteroid insects, neurosecretory material has been described only in the corpora cardiaca. In the earwig *Anisolabis maritima*[9], the locust *Schistocerca gregaria*[10], the cockroach *Leucophaea maderae*[11], and the grasshopper *Melanoplus sanguinipes*[12], no mention has been made of the presence of neurosecretory material in the aorta wall. In *Gryllotalpa africana*[13] neurosecretory material has been described in the corpora cardiaca along the aorta wall. AWASTHI[14] has made a positive statement that the aorta wall does not contain any trace of neurosecretory material in the house cricket *Gryllodes sigillatus*. From the references cited above, it would thus appear that the orthopteroid insects constitute a separate category, differing from the Hemiptera, Diptera and Coleoptera in having neurosecretory material in the corpora cardiaca but not in the aorta wall.

The present work was done on 3 species of insects, viz. the cockroach *Periplaneta americana*, the field cricket *Gryllus bimaculatus* and the mantid *Hierodula coarctata*. The retrocerebral complex was processed, stained with Paraldehyde Fuchsin (PF) and Chrome Haematoxylin-Phloxine (CHP), and examined for the presence of neurosecretory material in the corpora cardiaca and aorta wall. It was found that, in most of the mature adult females, neurosecretory material was present in the corpora cardiaca but not in the aorta wall. In a few cases, however, neurosecretory material was distinctly present in the aorta wall and had identical staining property with that of the neurosecretory material in the corpora cardiaca (Figures 1–3). In all the three species examined the neurosecretory material in the corpora cardiaca and the aorta wall stains blue-black with CHP and deep purple with PF.

The fact that the neurosecretory material has been found only in some stages in the aorta wall indicates periodic activity. It also accounts for the fact that previous authors did not find neurosecretory material in the aorta wall. Unfortunately, since the insects in the present work were not obtained from laboratory-reared colonies, the precise stage in the life cycle during which the neurosecretory material was found could not be ascertained. The present observations show that in the presence of neurosecretory material, both in the corpora cardiaca and aorta wall, the orthopteroid condition is similar to that reported for the Diptera, Coleoptera and some Hemiptera. Thus, on the basis of presence of neurosecretory material in the retrocerebral complex, insects can be divided into 2 groups: in some Hemiptera[6–8] it is present only in the aorta wall, while in the Diptera[3,4], Coleoptera[5], some Hemiptera[1,2] and orthopteroid insects it is found both in the corpora cadiaca and the aorta wall.



Sections through the corpora cardiaca (CC) and the aorta wall (AO) showing neurosecretory material (NSM) in these structure.

Fig. 1. *Periplaneta americana*. ×630.

Fig. 2. *Gryllus bimaculatus*. ×630.

Fig. 3. *Hierodula coarctata*. ×890.

Zusammenfassung. Bei verschiedenen Orthopteren wurde neurosekretorisches Material nicht nur im Corpus cardiacum, sondern auch in der Aortenwand gefunden, wie dies bereits bei Dipteren, Coleopteren und Hemipteren beobachtet wurde.

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