sensory process is a ciliary segment with a 9+0 type centriole organization. The terminal segment of the process is slightly dilated and rich in microtubules with scattered dense material and the distal end of the scolopale constricts a set of three dilatations of the terminal segment (figure, c). 3 sensory processes run along the scolopale side of the inner wall of the scolopale cavity so that the ciliary process bends along the curvature of the scolopale which itself warps to provide the cavity (figure, a and d). This ciliary bending seems to be characteristic of scolopidial transduction[8-12]. Tension applied to the scolopidium either straightens the bent cilium or activates the bending of the motile cilium[13]. Neural excitation follows in either case. When hair deflection produces tension in the chorda, the sensory afferent increases its firing frequency[7]. We also observed similar scolopidia in 2 other functionally identified mechanoreceptors: the telson hair[14] and the statocyst hair[15].

EM studies on these hairs have been reported elsewhere[16,17], but no reconstruction of the transducing element has been performed. The sensory structure described here closely resembles the sensory element of a proprioceptive chordotonal organ recorded in a shore crab limb[8]. Similar multi-sensory scolopidia have been also reported in the stretch receptors and in Johnston's organ of insects[9]. On the one hand, these scolopidial sense organs have so far been regarded as a chordotonal organ in which the scolopophore connects to the exoskeleton surface with a ligament under tension and there is no exoskeletal structure. On the other hand, the cuticular mechanoreceptors in insects, e.g. trichoid and campaniform sensilla, have no scolopidia as the sensory elements. Schmidt[11] however proposed that the sensory structures of these sensilla are homologous to those of the insect chordotonal organ.

Based upon the present discovery that the scolopidium in crustacea acts as the sensory element of a hair sensillum, it is likely that the sensory structures in both cuticular and subcuticular mechanoreceptors in arthropods have a homologous origin.

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Circadian rhythm of plasma corticosterone in vagotomized rats

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Summary. In vagotomized rats, 2 weeks after surgery, the amplitude of the circadian rhythm of plasma corticosterone was extremely low, indicating that gastrointestinal activity may be in part involved in the hypothalamo-hypophyseal circadian rhythmicity.

Previous observations indicated that the circadian rhythm of plasma corticosterone is not only entrained by the light-dark cycle but also influenced by eating and drinking[1-5]. Following a 14-day restricted feeding schedule the peak of plasma corticosterone was observed just prior to feeding time and the elevated level declined promptly after food presentation[6]. Such alteration of the rhythm was assumed to be produced by a central mechanism. However, there is a possibility that gastrointestinal activity might be involved in the change of rhythm pattern of the plasma corticosterone level. If so, visceral stimulation may be in part transported to the hypothalamo-hypophyseal system via the vagus. The present investigation was therefore carried out to investigate participation of the vagus in the circadian rhythm of plasma corticosterone using vagotomized rats.

Methods. Female Wistar rats, 8 weeks of age, were used. They were housed at a constant temperature of 25±2 °C with a regulated photoperiod of 12 h, lights on at 07.00 h, and rat biscuit (Oriental Yeast Co.) was given with water ad libitum.

Subdiaphragmatic vagotomy was done under nembutal anesthesia. Through an upper abdominal midline incision the esophagus was isolated from its surrounding tissue near the esophago-gastric junction and the vagal nerve trunks were removed. In sham-operated rats the vagal nerves were kept intact after the isolation. The operated rats were used for experiments 14 days after surgery. The animals were sacrificed by decapitation and trunk blood was collected, 7 times during the day, from 06.00 h to 24.00 h, as seen in the figure. Plasma corticosterone was determined by the method of Zenker and Bernstein[7] with minor modifications. The stomachs of the vagotomized rats showed atonic distension, and vagotomy was verified anatomically using a dissecting microscope.

For data analysis Student's t-test was used. Moreover, a 24-h cosine curve was fitted by the method of least squares to obtain the mesor, amplitude and acrophase, employing an electronic computer[8].

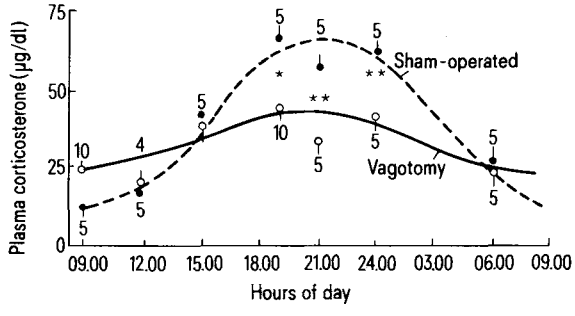
Results. In vagotomized rats the peak value of plasma corticosterone was 45.6±4.74 (SEM) μg/dl at 19.00 h and the trough 20.3±4.06 μg/dl at 12.00 h, while in sham-

Circadian rhythm of plasma corticosterone in vagotomized and sham-operated rats

	Sham-operated	Vagotomized
Mesor (μg/dl)	38.3	33.5
Amplitude (μg/dl)	28.4	9.5
Acrophase (h)	21.28	20.30

operated ones 67.2 ± 3.15 µg/dl at 19.00 h and 11.3 ± 3.60 µg/dl at 09.00 h, respectively. As seen in the figure, the corticosterone levels of the vagotomized rats were significantly lower at 19.00, 21.00 and 24.00 h, while higher at 09.00 h as compared with corresponding levels in the sham-operated ones. When computed results for the vagotomized group were compared with those of the sham-operated one, the mesor and acrophase were similar in both groups, but a large difference was seen in the amplitude. It was 28.4 µg/dl in the sham-operated group, but only 9.5 µg/dl in the vagotomized one, as shown in the table and the figure.

Discussion. A number of studies have demonstrated that a restricted feeding and/or watering schedule are capable of entraining the circadian rhythm of plasma corticosterone[1-6]. In these reports a very rapid fall in the plasma levels of corticosterone was observed following presentation of food and water. There might be some inhibitory pathways in the central nervous system to suppress ACTH secretion in relation to feeding and watering, but the mechanism of the inhibitory processes are not yet known[9,10]. In this respect, indirect influence of gastrointestinal activity cannot be excluded, since subdiaphragmatic vagotomy was found to cause a marked reduction in the amplitude of plasma corticosterone rhythmicity. The fact suggests that decreased secretion and movement of the gastrointestinal tract induced by ablation of the vagus causes a reduction of rhythmic variation of ACTH secretion, or that afferent impulses from the gastrointestinal tract to the central nervous system via the vagus are involved in the circadian rhythm of the pituitary-adrenal system. The possibility that a lack of vagal mediated insulin secretion plays a role in the reduced circadian rhythmicity should also be considered. However, so far as we examined it, no difference was observed in blood sugar levels between the 2 groups of rats at 09.00 and 19.00 h. Therefore, decreased insulin secretion would not be the main cause of the reduced circadian rhythmicity.



Circadian rhythm of plasma corticosterone in sham-operated (●---●) and vagotomized (○——○) rats. Vertical lines indicate SEM. Numbers in the figure are the number of rats. *$p < 0.05$, **$p < 0.01$.

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The plasma volume of the Wistar rat in relation to the body weight

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Summary. The plasma volume of 43 male Wistar rats, weighing between 140 and 350 g, was determined. A close linear relationship between plasma volume and body weight was found: plasma volume (ml) = 0.0291 × body weight (g) + 2.54.

Knowledge of the plasma volumes of experimental animals is of practical importance for many investigators, for instance those studying the clearance of injected proteins from blood[2,3]. A number of authors[4-11] have determined the plasma volumes of rats by measuring the plasma concentration of an i.v. injected indicator, e.g. a radioiodinated protein or the dye Evans' Blue (also known as T-1824). Plasma volumes have been determined either from a single sample taken shortly after injection, or by extrapolating the plasma clearance curve. Values for the plasma volume of the rat given in the literature concern groups of animals within a more or less narrow range of body weights; the relation between plasma volume and body weight has (with 1 exception, see below) not been investigated. We have now determined this relation in normal male Wistar rats weighing between 140 and 350 g. The results are compared with data from the literature.

Materials and methods. Male rats of an inbred Wistar strain (T.N.O., Zeist, The Netherlands), weighing between 140 and 350 g, were used. The animals were fed ad libitum on a complete laboratory diet (Hope Farms, Woerden, The Netherlands) and received water ad libitum. All experiments were done on anaesthetized animals. Anaesthesia was induced and maintained with Fluothane (I.C.I., Macclesfield, Cheshire, G.B.) in a mixture of NO and O_2. Bovine serum albumin (Sigma, St. Louis, Mo, USA), labelled with 125-iodine as described by Kooistra et al.[2], was used as indicator. In order to remove any traces of rapidly cleared material, the labelled albumin (10 µCi ^{125}I/mg of protein) was screened before use. Screening was done by injecting 20 mg labelled albumin dissolved in 0.50 ml phosphate buffered saline (6 mM sodium phosphate buffer, pH 7.35, containing 0.15 M NaCl) in a rat of 250 g. After 1 h the animal was killed and the plasma collected. This plasma, containing screened radiolabelled albumin, was used for plasma volume determinations after 3-4-fold dilution with phosphate buffered saline. Solutions used for injection were always centrifuged at 15,000 × g for 30 min immediately before injection in order to remove any traces of insoluble material.

Rats were injected via the penile vein, with 0.20 ml labelled plasma (containing about 1 µCi ^{125}I) per 100 g b.wt. Mixing