latency of peak (*d*) for a click stimulus recorded over the auditory area is approximately 110 msec. In this study, the magnitude of the wave defined as (*c-d-e*) constituted the principal criterion for comparing the evoked potentials elicited under the different experimental conditions. The long latency and diffuse cortical representation of this wave suggests that it is a secondary potential (*4*), perhaps related to the nonspecific sensory system.

Figure 1 presents characteristic data from two of the 13 subjects studied under each of the three experimental conditions. Under the vigilance condition, when subjects were attending to the flash stimuli (visual vigilance task), the amplitude of the visually evoked response (VER) to flashes, recorded from the occipital area, was much greater than when subjects were attending to the click stimuli (auditory vigilance task). Similarly, when subjects were attending to the click stimuli (auditory vigilance task), the amplitude of the auditory evoked response (AER) to clicks recorded from the temporal area, was greater than when subjects were attending to flashes (visual vigilance task). All 13 subjects in the experiment showed VER and AER differences between tasks of the type illustrated in Fig. 1. Basically similar data were obtained when the subjects were under the key-pressing condition: here also the VER and AER amplitudes were greatest when subjects were attending to stimuli in the corresponding sense modality. Thus, when subjects were performing the visual key-pressing task (pressing the key after each flash), the amplitude of the VER's to flashes was greater than when the subjects were pressing the key after each click. Again, all 13 of the subjects showed VER and AER differences between attentive and inattentive conditions of the kind illustrated in Fig. 1. Data obtained with the subjects under the counting condition were equivocal. Six subjects showed differences of the kind found under the other two conditions; three subjects showed no differences; and four subjects showed differences in the opposite direction. As we will explain below, counting may be a task which divides rather than focuses attention.

These data indicate that when attentiveness is effectively manipulated between sense modalities, the amplitude of cortical evoked responses in a given sense modality varies according to whether or not the subject is attending to stimuli in that or another modality. It is important to note that subjects in this experiment were required to be alert for relatively short periods of time (10 minutes). This contrasts with the situation in the experiment we reported previously (*1*), in which subjects performed a vigilance task lasting nearly 2 hours. Attentiveness inevitably fluctuated considerably during performance of that prolonged task, as subjects were usually highly alert at the beginning and much less so at the end. It remained an open question, therefore, whether changes in the cortical evoked responses with changes in attentive state would occur in a continually alert subject. Data obtained under the conditions of the present experiment allow us to state unequivocally that, even in an alert subject, changes in evoked responses occur which are related to the subject's attentive state.

Several other workers have examined the effect of selective attentiveness on cortical evoked responses in humans (*5–9*). Their results have been varied and therefore inconclusive, perhaps because of the varied procedures employed in establishing attentive sets. For example, van Hof *et al.* (*5*) reported that attending to flash stimuli by counting them had no effect on the amplitude of the evoked responses to the flashes. On the other hand, Jouvet (*6*) and Garcia-Austt *et al.* (*7*) reported that counting flash stimuli enhanced the amplitude of the VER. In contrast, Callaway *et al.* (*8*) recently reported that patients showed a decrease in AER amplitude while attending to bursts of tone. The procedures used by the various investigators suggest that the method by which an attentive set was established may have been an important determinant of the findings in a particular experiment. In our experiment, the vigilance and the key-pressing tasks were effective in enhancing cortical evoked responses, whereas the counting task was relatively ineffective. Counting, rather than focusing attention on relevant stimuli, may be distracting because of the necessity of keeping track of the number of stimuli counted. In most of the studies cited above, a counting task was used to elicit attentiveness. The equivocal results obtained may have been because of this.

Our results seem to indicate conclusively that when an attentive set is established by making subjects perform a perceptual discrimination which requires close attention to every stimulus, the amplitude of the cortical evoked responses varies with the attentive set of the subject.

PAUL SPONG
MANFRED HAIDER*
DONALD B. LINDSLEY
Departments of Psychology and Physiology, University of California Los Angeles 90024

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* Permanent address: Hygiene Institute, University of Vienna.

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Carotid Sinus and Aortic Reflexes in the Regulation of Circulation during Sleep

Abstract. *In the cat with intact sino-aortic reflexes, episodes of deep sleep are accompanied by marked falls in both systolic and diastolic blood pressure. The falls are much larger after bilateral sino-aortic deafferentation: to such low pressures during deep sleep that episodes of transient cerebral ischemia (electroencephalographic flattening and seizures) sometimes occur.*

It has been known for years that arterial pressure is somewhat decreased during sleep, both in experimental animals and in man (*1*). In cats and dogs (*2*), however, decrease in pressure is only slight during light sleep, when synchronized patterns are present in the electroencephalogram, and when electromyographic activity of the neck indicates persistence of postural tone. A more marked fall, of 20 to 30 and sometimes 40 mm-Hg, occurs only during rhythmically occurring episodes of deeper sleep, signaled by a desynchronized electroencephalogram, a flat elec-

Table 1. Means and standard errors of the mean (S.E.) of systolic and diastolic arterial pressure (in millimeters of mercury) during various stages of the WSC in cats with intact sino-aortic reflexes (Intact animals) and in cats after sino-aortic deafferentation (Deafferented animals). Last column on the right, *p*: comparison of blood pressure values between the two groups of animals (intact or deafferented), as evaluated by analysis of variance and expressed as probability. Conditions: Waking, blood pressure during quiet wakefulness at the beginning of each recording session; Light sleep lowest, lowest blood pressure recorded during light sleep; Deep sleep initial, blood pressure at the very beginning of deep sleep episodes; Deep sleep lowest, lowest blood pressure recorded during deep sleep.

Condition	Intact animals			Deafferented animals			*p*
	n	Mean	S.E.	*n*	Mean	S.E.	
Systolic pressure							
Waking	22	118.0	4.8	18	138.1	5.0	<.01
Light sleep lowest	82	102.0	2.4	142	114.1	1.9	<.001
Deep sleep initial	82	110.3	2.4	145	131.2	2.6	<.001
Deep sleep lowest	82	85.5	2.1	145	71.8	1.9	<.001
Diastolic pressure							
Waking	22	67.2	2.6	18	76.1	3.5	<.05
Light sleep lowest	82	59.5	1.5	142	63.6	1.5	>.05
Deep sleep initial	82	65.4	1.7	145	78.4	2.1	<.001
Deep sleep lowest	82	46.8	1.3	145	30.9	1.3	<.001

tromyogram of cervical muscles, and bursts of rapid eye movements. During this kind of sleep (referred to hereinafter as deep sleep) marked oscillations of arterial pressure are often recorded, as well as periods of bradycardia and tachycardia, phenomena which have also been reported in man (*3*), and which fit well into current theories of active processes in the brain stem during deep sleep (*4*).

These observations are of more than descriptive interest: they indicate that the neural mechanisms of wakefulness and sleep involve also cardiovascular regulation. One of the most important factors in circulation homeostasis resides in the reflexes arising in the carotid sinus and in aortic and cardiopulmonary areas (*5*). Therefore, useful information on circulatory control during sleep might be provided by comparing the effects of deep sleep on blood pressure in animals with intact sino-aortic reflexes with such effects after sino-aortic deafferentation.

The observations here reported (*6*) were made in 24 cats, 6 of which were studied both before and after sino-aortic deafferentation. Of the other 18 animals, 10 were studied with intact reflexes and 8 after deafferentation only. The latter procedure was performed under pentobarbital anesthesia (30 mg/kg, intraperitoneal) and consisted in cutting both carotid sinus nerves and in carefully stripping the carotid sinus walls; the aortic nerves were identified at their junctions with the superior laryngeal nerves, isolated from the cervical vagus trunks, and bilaterally severed. Cardiopulmonary afferents coursing in the vagi were left intact to avoid the adverse effects of bilateral vagotomy. Blood pressure was recorded in the free-moving animal by means of a thin polyethylene tube permanently implanted in a femoral artery and connected with a variable inductance transducer (Sanborn 267 B). Coagulation was prevented by intravenous injections of heparin (25 mg) twice a day. The behavior of the animals was observed through the large glass window of a sound-attenuating, electrically isolated, illuminated cage. For evidence of the various stages throughout the wakefulness-sleep cycle (WSC), the following phenomena, besides arterial pressure, were simultaneously recorded by a multichannel inkwriter (*7*): electrical activity from the right and left cerebral hemispheres, monitored by screw-electrodes implanted in the skull; eye movements, through screw-electrodes in both orbits; and electromyograms from the neck, obtained through two needles permanently inserted into the paravertebral cervical muscles. All recording sessions took place at least 3 days after implantation of electrodes or after sino-aortic deafferentation.

Means and standard errors of the means of systolic and diastolic arterial pressure during different stages of the WSC, as calculated from pooled observations in animals with intact reflexes, appear in the first three columns of Table 1; similar data from pooled observations on deafferented cats are also shown. Statistical evaluation of blood pressure in the two groups of ani-

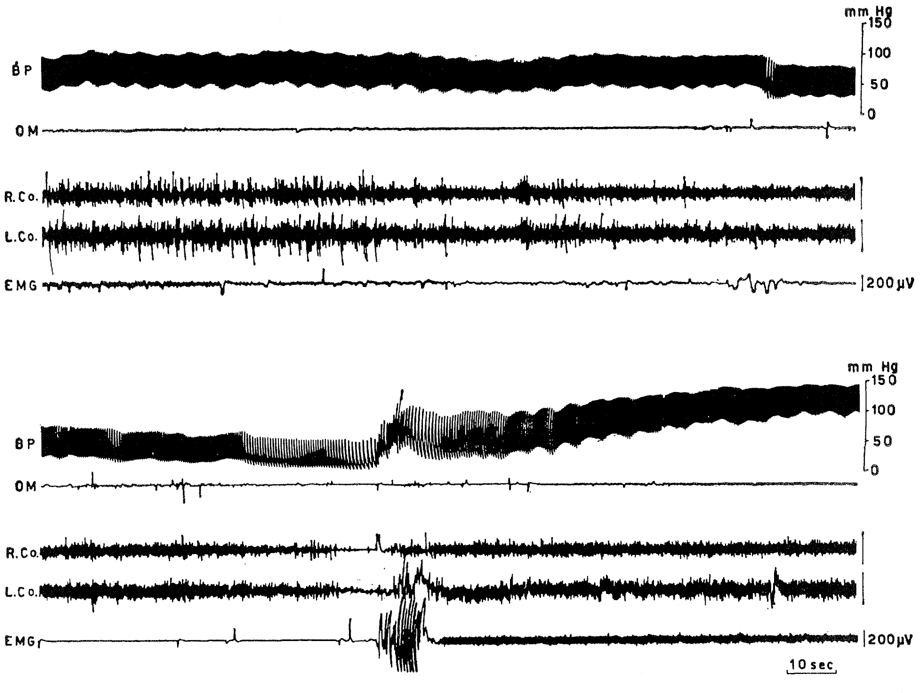

Fig. 1. Dramatic decrease in arterial pressure, accompanied by electroencephalographic flattening and generalized seizure, during transition from light synchronized to deep desynchronized sleep in a cat with bilateral sino-aortic deafferentation. *BP*, Blood pressure; *OM*, ocular movements; *R.Co.*, electroencephalogram from right cerebral cortex; *L.Co.*, electroencephalogram from left cerebral cortex; *EMG*, electromyogram of the neck. Lower half of the figure is continuous with upper half. Note that arterial pressure falls from 110 (systolic) and 50 mm-Hg (diastolic) during final period of synchronized sleep to 50 and 0 mm-Hg, respectively, after less than 2 minutes of desynchronized sleep. At these extremely low values, accompanied by intense bradycardia, convulsive waves appear on both electroencephalographic leads, soon followed by complete flattening of cortical electrical activity. The gross artifacts in the electromyogram signal onset of a generalized seizure, followed by behavioral arousal and a marked hypertensive rebound.

mals (intact or deafferented cats) was carried out by analysis of variance (*8*); the results appear as probability in the last column of Table 1.

With intact animals, light sleep was accompanied by slight but definite decrease in both systolic and diastolic blood pressures (Table 1, Light sleep lowest). Pressure falls were more consistent during episodes of deep sleep. Although these falls were somewhat emphasized by a small rise in blood pressure at the very beginning of a deep-sleep period (Deep sleep initial), they were never dramatic (averaging 24.8 mm-Hg for systolic, and 18.6 mm-Hg for diastolic pressure), and there were no exceedingly low values of arterial pressure during the deep sleep of intact animals (Deep sleep lowest).

Changes in similar directions, but with some striking quantitative differences, were observed in animals with sino-aortic deafferentation. As indicated in Table 1, systolic and diastolic blood pressures were significantly higher in these than in intact animals both during quiet wakefulness (Waking) and throughout light sleep (Light sleep lowest), although under the latter condition a consistent decrease in pressure usually occurred, as previously reported for the dog (*9*). In spite of the fact that higher pressures were still observed in deafferented animals at the beginning of deep sleep (Deep sleep initial), such surprisingly large falls in pressure were recorded during the course of deep-sleep episodes (average falls: 59.4 and 47.5 mm-Hg for systolic and diastolic blood pressure, respectively) that arterial pressure finally attained much lower absolute values in deafferented than in intact animals (Deep sleep lowest). Not infrequently, such values were low enough to endanger an animal's survival. Systolic values were lower than 65 mm-Hg during deep sleep in 46 out of 145 episodes in deafferented animals, but in only 6 of 82 observed episodes in intact animals; likewise, diastolic values lower than 30 mm-Hg (never observed in intact animals) occurred in 63 of 145 episodes of deep sleep in deafferented cats. In several incidents of the lowest values of blood pressure, and particularly whenever diastolic pressure approached or attained 0 mm-Hg, the electrocorticogram rapidly flattened, and some convulsive waves heralded a generalized seizure (Fig. 1); all of a sudden the arterial pressure showed a prolonged hypertensive rebound and the animal awoke in fright, the electroencephalogram promptly returning to its normal waking appearance. These dramatic signs of transient cerebral ischemia, though observed in only a few deafferented animals, never occurred either in our groups of intact animals or in several hundred normal cats whose sleep behavior was recently studied in our laboratory.

Since section of the carotid sinus and aortic nerves interrupts both presso- and chemoceptive fibers, we cannot conclude that abolition of the pressoceptive rather than the chemoceptive reflexes is responsible for the falls in systolic and diastolic blood pressure to such dramatically low levels. It is difficult to explain the occurrence of lower pressures in deafferented than in intact animals, either with the classical conception that pressoceptive inactivation releases pressor centers from a tonic inhibitory inflow, or with the current opinion that the role of chemoceptors in circulatory regulation is limited to such emergencies as acute anemia or anoxia. While other explanations cannot be ruled out at present, our observations suggest that the actual functions of sino-aortic reflexes in unanesthetized normal animals may differ, at least in part, from the patterns inferred from the classical experiments on anesthetized or decerebrate animals.

Maurizio Guazzi
Alberto Zanchetti
Istituto di Patologia Medica, Università di Siena, and Impresa di Elettrofisiologia del Consiglio Nazionale delle Ricerche, Siena, Italy

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Impaired Recovery from Hypothermia after Anterior Hypothalamic Lesions in Hibernators

Abstract. *Hypothermia was induced by hypercapnic hypoxia in thirteen-lined ground squirrels,* Citellus tridecemlineatus. *When the squirrels were allowed to recover normal body temperatures at a 10°C ambient temperature, those with anterior hypothalamicpreoptic lesions took three to four times longer than normal controls to reach a body temperature of 35°C.*

The anterior hypothalamic-preoptic area plays an important role in physiological (*1*) and behavioral (*2*) temperature regulation in homeothermic animals. Animals with lesions in this area lose the ability to maintain normal temperatures when exposed to a cold environment (*3*). Nothing is known, however, of the function of this region in hibernators. The experiment described here concerns the effects of ablation of the rostral hypothalamus on recovery from induced hypothermia in the thirteen-lined ground squirrel, *Citellus tridecemlineatus.*

Twenty-four female squirrels weighing from 190 to 300 g were used. Sixteen were operated on, each being given a standard dose of 0.4 ml atropine sulfate (U.S.P. grade) (concentration 0.4 mg/ml) before being anesthetized with Nembutal (50 mg/kg of body weight) injected intraperitoneally. The scalp was incised, and a hole drilled stereotaxically over the superior sagittal sinus. Bilateral electrolytic lesions of varying sizes were made in the vicinity of the anterior hypothalamic-preoptic area. The stereotaxic coordinates found to be most effective in producing a deficit, with the animal's head in a horizontal position, were A 8.5, L 0.6, and 8.0 to 8.5 mm below the dural surface. The squirrels were operated on in pairs matched for weight, and after surgery each animal was given a standard intramuscular injection of 0.3 ml procaine penicillin (300,000 U/ml) and was put in an individual cage. At this time a control animal for each pair, matched as closely as possible for weight, was also taken