four patients were medicated with pentobarbital 100 mg., morphine 10 mg., and atropine 0.7 mg. per 70 kg. of body weight, given one hour prior to study. Tidal volume and respiratory rate were measured with subjects breathing from a calibrated ventimeter in a circle system and recorded with a Grass direct writing recorder. Simultaneous brachial arterial blood samples were drawn for *p*H and P_{CO_2}, using the Astrup technique. TCE was vaporized in two Vernitrol vaporizers, the approximate inspired concentration being calculated from vaporizer and diluent oxygen flows, knowing TCE vapor pressure at the existing temperature. Following control measurements, anesthesia was induced with thiopental (100 to 350 mg. intravenously) and maintained at 2 per cent TCE in O_2 via an endotracheal tube and nonrebreathing system (Stephen-Slater valve) for approximately one hour. Subjects were then temporarily returned to the circle system and ventilatory and blood-gas data obtained at this concentration. This procedure was repeated after approximately 30 minutes at 1 per cent TCE. No surgical stimulation was present during this study. *Results:* Under TCE anesthesia, tidal volume of nonpremedicated patients fell markedly (mean control—453 ml.; 1 per cent TCE—177 ml.; 2 per cent TCE—176 ml.) but the profound tachypnea which ensued (control—15/minute; 1 per cent TCE—48/minute; 2 per cent TCE—55/minute) resulted in a moderate increase in minute ventilation (control—6.7 liters/minute; 1 per cent TCE—8.3 liters/minute; 2 per cent TCE—9.3 liters/minute). However, most of this additional volume was expended in ventilating airway dead space, since no appreciable change occurred in arterial P_{CO_2} (control—35.9 mm. of mercury; 1 per cent TCE—39.2 mm. of mercury; 2 per cent TCE—37.8 mm. of mercury). In premedicated patients, tidal volume also fell (mean control—537 ml.; 1 per cent TCE—216 ml.; 2 per cent TCE—190 ml.), but the tachypnea which ensued (control—11.5/minute; 1 per cent TCE—51/minute; 2 per cent TCE—50/minute) resulted in an increased minute ventilation (control—6.1 liters/minute; 1 per cent TCE—10.8 liters/minute; 2 per cent TCE 9.7 liters/minute). Some change occurred in arterial P_{CO_2} (control—35.9 mm. of mercury; 1 per cent TCE—37.6 mm. of mercury; 2 per cent TCE—43.5 mm. of mercury), although no patient exhibited severe respiratory acidosis. TCE did not appear to alter ventilatory responses to CO_2 challenges in premedicated or unpremedicated man. *Conclusions:* These preliminary investigations suggest that under the circumstances of this study, TCE is not a respiratory depressant in man. Alveolar ventilation was adequately maintained at surgical concentrations of TCE and in contrast to data in cats, there did not appear to be any elevation in CO_2 threshold for ventilation or depression in CO_2 responsiveness.

Neuromuscular Effects of Cyclopropane. ALAN VAN POZNAK, M.D., *Associate Attending Anesthesiologist, New York Hospital and Clinical Assistant Professor of Anesthesiology in Surgery, Cornell University Medical College, New York, New York; and* JOSEPH F. ARTUSIO, JR., M.D., *Anesthesiologist-in-Chief, New York Hospital and Professor of Anesthesiology in Surgery, Cornell University Medical College, New York, New York.* Cyclopropane produces two opposing effects on mammalian nerve-muscle preparations. There is potentiation of the direct twitch which is not abolished by curarization. Despite this potentiation of direct twitch, a second and separate effect involving neuromuscular block is evident, because the indirect twitch is reduced more by the combination of cyclopropane plus *d*-tubocurarine than by *d*-tubocurarine alone. This study is concerned with the unusual picture of increasing twitch tension in the presence of increasing neuromuscular block. *Method:* Cats either anesthetized with chloralose or decerebrated were prepared for recording of twitch tension from soleus or gastrocnemius. Curarized and noncurarized muscles were examined. Electomyograms were observed for both muscles. Motor nerve terminal activity in single axon preparations was measured as the time during which repetitive discharge could be elicited by single shocks following a 10-second tetanus; the per cent depression of duration of nerve repetition induced by cyclopropane was determined. Reserpinized or chronically denervated cat preparations were also examined, as well as *in vitro* frog sartorius preparations. Inhaled cyclopropane concen-

trations were administered ranging from 5 to 40 per cent. A nonrebreathing system with mechanical hyperventilation was used. Carbon dioxide 3–4 per cent was added to maintain control CO_2 levels. *Results:* Neuromuscular block in the presence of muscle twitch potentiation was suggested by the divergence of dose-response curves for non-curarized and curarized cat soleus and gastrocnemius. Curarized direct preparations were potentiated more by cyclopropane than were indirect preparations, suggesting that some degree of neuromuscular block existed in the latter. Motor nerve terminal activity as measured by post-tetanic repetitive activity showed uniform depression of the prejunctional element. This was interpreted as evidence for incipient neuromuscular block. Post-tetanic potentiation, a consequence of motor nerve terminal repetition in cat soleus, was depressed or abolished by cyclopropane. In cat gastrocnemius, however, where post-tetanic potentiation is generated within the muscle and not by nerve terminal repetition, cyclopropane prolongs the duration of post-tetanic potentiation. The degree of potentiation is greater in gastrocnemius muscle than in soleus for both curarized and non-curarized preparations. In frog sartorius (as distinct from cat preparations) neuromuscular block rather than muscle potentiation is the predominant effect; muscle potentiation is prominent only in the curarized direct twitch. *Conclusions:* Through the examination of different muscles and different species, marked and varied effects of cyclopropane on the neuromuscular complex become evident. In clinical practice, the inability of ordinary doses of cyclopropane to produce profound muscle relaxation may be related to potentiation of muscle; with higher doses, even though muscle becomes more sensitized, profound relaxation can be secured because nerve impulses are blocked from muscle at either central synapses or the neuromuscular junction.

The Effect of Vagolytic Drugs on Ventricular Arrythmias During Cyclopropane Anesthesia. LEONARD F. WALTS, M.D., and WILLIAM MCFARLAND, M.D., *University of California, Los Angeles, School of Medicine, Department of Surgery/Anesthesiology, Los Angeles, California.* Atropine given intravenously during cyclopropane anesthesia produced severe disturbances in ventricular rhythm in 52 per cent of patients tested (Jones, R. E., Deutsch, S., and Turndorf, H.: ANESTHESIOLOGY 22: 67, 1961). Walts and Prescott in an unpublished study found that gallamine, which has as a side effect cardiac vagolysis, produced similar disturbances in 56 per cent of patients tested. In the latter study, the authors observed that a second dose of gallamine, given after a return to normal sinus rhythm, failed to produce further abnormality in rhythm. This suggested the possibility that the first administration of gallamine afforded protection against the subsequent dose. *Method:* Healthy adult patients were divided into 2 groups. In group 1, 25 patients were given atropine or scopolamine, 0.3 to 0.4 mg. intramuscularly, with premedication. They received 0.6 mg. of atropine intravenously prior to the induction of anesthesia. Following induction with a thiobarbiturate and tracheal intubation, facilitated by using succinylcholine chloride, anesthesia was maintained with cyclopropane and oxygen. Respiration was controlled with a ventilator set to deliver a tidal volume 10 per cent in excess of predicted normal volume calculated from the Radford nomogram. After approximately 15 minutes, 100 mg. of gallamine were injected intravenously. In group 2, the regimen of the 25 patients differed in that they received 1.2 mg. of atropine prior to the induction of anesthesia and were challenged with 0.4 mg. of atropine rather than gallamine after approximately 15 minutes of cyclopropane and oxygen anesthesia. Changes in ECG, pulse, and blood pressure as a result of the atropine or gallamine challenge were noted and end-tidal P_{CO_2} was measured in 5 patients. *Results:* All patients were in a moderate depth of anesthesia (EEG levels 2 to 4). End-tidal P_{CO_2} was less than 40 mm. of mercury in all measured cases. In group 1, following the gallamine, only 3 patients (12 per cent) developed ventricular arrhythmias. In group 2, 3 patients (12 per cent) developed disturbances in ventricular rhythm in response to the atropine. *Comment:* It has long been known that increased sympathetic tone during cyclopropane anesthesia precipitates ventricular arrhythmias. The autonomic imbalance can be