electrocardiogram was obtained. All measurements were recorded on a 6-channel polygraph. The gas mixture was prepared in a large high pressure cylinder and delivered to a 5-liter reservoir bag via a regulator and flow meter and thence through the nonrebreathing valve to the subject. Two-tenths per cent halothane in air was inspired. Some pharmacologic effects were noted with this low concentration, including occasional loss of attention, drowsiness and lightheadedness. The rate and depth of respirations were controlled with a chest cuirass respirator. The tidal volume usually exceeded 0.7 l. to assure near identity of end-expiratory and alveolar gas tensions. This was adjusted so that the end-expiratory P_{CO_2} was near normal. Corrections were made for apparent changes in halothane concentration related to the $(\dot{V}_{O_2} - \dot{V}_{CO_2})$ difference and water vapor. No correction was made for the halothane absorption since calculation indicated that it would be insignificant and would decrease as the study progressed. *Results and Comment:* A measure of the degree of equilibration between tissues and an inspired gas is the relation of the expired and inspired gas tension. This relation, expressed as a ratio (F_E/F_I) is zero when inhalation of the gas starts and attains unity when uptake by the body ceases and equilibrium is achieved. Halothane uptake is not rapid. The height of the initial rise is moderate, typically reaching approximately 35 per cent of the inspired concentration at one minute, 50 per cent at 5 minutes, and 55 per cent at 10 minutes. The inflection is gradual, taking place over a period of 30 minutes. At 40 minutes, 70 per cent saturation is reached and after that the ratio rises more and more slowly. Eighty per cent is attained at 2 hours and by extrapolation it is apparent that 10 to 12 hours would be required to reach 95 per cent saturation. In sharp contrast, the uptake of cyclopropane is rapid. The initial rise is greater, it is brisk and decisive—attaining 55 per cent of the inspired concentration at one minute, and 90 per cent at 5 minutes. The inflection is sharp, occurring over a period of 2 to 3 minutes. By 10 minutes 95 per cent has been reached, and the period of slower and slower rise is entered. The data for halothane are consistent. Size and sex do not affect the results. Ventilation is important, however. A 50 per cent reduction in minute ventilation decreased the saturation ratio 15 to 25 per cent. The clinical implications of these data are: (1) administration of safe halothane concentrations is unlikely to cause the body's halothane content to quickly approach an anesthetic level. (2) For rapid induction, high concentrations of halothane must be used. (3) Ventilation must be maintained. (4) The decrease in inspired concentration should be a progessive one, matching the slow rise in the body's halothane content. (5) The inspired concentration can be decreased materially only when the curve is well around the inflection (30 to 40 minutes). (6) When these points are disregarded, the patient's halothane content cannot be expected to rise fast enough to reach an analgesic level quickly.

Impedance Plethysmography in Anesthesiology. REX J. UNDERWOOD, M.D., *Assistant Professor, Division of Anesthesiology, University of Oregon Medical School, Portland, Oregon.* The impedance plethysmograph is an electronic device which generates a high frequency current of very low intensity. This current is applied across two electrodes which may be attached to any body segment. Changes in volume occurring as a result of pulsatile blood flow cause changes in the electrical impedance of the segment and consequent variations in the intensity of current flow between the electrodes. These current changes may be amplified and recorded by a standard electrocardiograph machine. The resultant record is similar in form to an intra-arterial pressure tracing. This report is concerned with use of this device in two aspects of anesthesiology: (1) sympathetic nerve blocks and (2) monitoring during anesthesia. *Results:* A successful sympathetic nerve block to an extremity results in an increase in amplitude of the plethysmographic tracing due to the release of vasomotor tone and an increase in pulsatile flow. In cases of suspected vasospastic disease, the amount of change in pulsatile flow after a sympathetic block has been helpful in diagnosis and in predicting the benefit of a sympathectomy. During anesthesia, the impedance plethysmograph has proved useful in determining blood pressures.

The electrodes are placed on an extremity, distal to a pneumatic blood pressure cuff. Systolic pressure is determined by inflating the cuff above the pressures at which pulsations disappear and then noting the point at which pulsations begin during slow deflation. Diastolic pressure is taken as the point at which the pulsations attain their maximum amplitude. This method of blood pressure determination has been of particular value with infants and small children in whom auscultatory or palpatory pressures may be difficult or impossible to obtain. The lower limit of systolic pressure at which plethysmographic pulsations may be obtained is usually 20–30 mm. Hg. A further use of the impedance plethysmograph as a monitoring aid is the observation of alterations in waveform occurring as a result of changes in peripheral resistance or cardiac output. In patients who are acutely hypovolemic from hemorrhage or who have a sudden decrease in cardiac output, an increase in the diastolic runoff time and disappearance of the dicrotic wave may occur. A similar increase in diastolic runoff time is seen as the result of vasopressor administration. A decrease in diastolic runoff time and an accentuation of the dicrotic wave is seen in plethysmographic tracings during deep ether or halothane anesthesia. These changes would not be evident by the usual methods of monitoring the circulation. The impedance plethysmograph has proven to be a useful diagnostic and teaching aid in the performance of sympathetic blocks and a valuable monitoring device particularly in pediatric anesthesia. The instrument provides a means of detecting changes in peripheral circulation which may occur as a result of alterations in such factors as blood volume or anesthetic depth.

Effect of Stimulus, Amplitude, Frequency, Duration, and Wave Form in Production of Electronarcosis. ALAN VAN POZNAK, M.D., AND JOSEPH F. ARTUSIO, JR., M.D., *Department of Anesthesiology, The New York Hospital-Cornell Medical Center, New York, New York.* Electronarcosis is in theory an attractive form of anesthesia because of the controllability of the anesthetic agent. In addition, there is no chemical to be excreted, detoxified, or distributed throughout the patient. While unconsciousness can easily be produced by many different types of electrical stimuli, there are frequently other effects which make electronarcosis appear less attractive than well managed general anesthesia. Untoward effects frequently seen include convulsions, rigidity, twitching, apnea, laryngospasm, bradycardia, arrhythmias, hypertension, and profuse salivation. Many workers have limited their investigation to a small portion of the electromagnetic spectrum. It was hoped that a more detailed examination of some of the electrical variables might suggest a type of current which would produce a more physiologic type of anesthesia. *Method:* Sine and triangular waves were generated with a Hewlett-Packard Function Generator. Square waves were generated with Grass S-4 stimulators which could be used to generate dissimilar synchronized pulses or modulated trains of identical pulses. These were observed on the screen of a DuMont type 322-A dual beam oscilloscope. In addition, an isolation transformer was used so that a DC bias could be introduced when desired. The stimuli were applied through silver or stainless steel electrodes through the mouth and to the shaven skin of the head of unmedicated and purposefully fed mongrel dogs. Clinical observation was made of the effects on respiration, heart rate, muscular activity, and analgesic action of the various wave forms. Because of the nature of the stimulus, monitoring of ECG or EEG was not done during the application of the current. Analgesia was considered adequate if there was no response to a clamp applied to the skin. The range of 1 to 10,000 cycles per second was studied. *Results:* The results were similar to those reported by many other workers. Stimuli strong enough to produce analgesic often bordered upon the convulsive threshold. Smooth regular respiration was rarely seen. Expiration was frequently forceful to the point that cyanosis developed. Laryngospasm occurred occasionally. Salivary secretions were profuse in all instances. The heart rate was usually rapid, but if a tonic seizure was induced the heart rate often became slow and irregular. Skin irritation and burning was occasionally present, but could be minimized by using moist electrodes. Recovery was rapid and uneventful. Trial of the stimuli upon the investigator's head confirmed the impres-