halothane, chloroform, ether, divinyl ether, trichloroethylene, cyclopropane and nitrous oxide. Elevation of toothpulp threshold in rabbits was the criterion of analgesic action. Electrical stimulation consisting of single, square wave pulses of one millisecond duration and variable voltage was delivered from a Grass Model S-4 instrument to insulated spring clip electrodes inserted into burr holes placed laterally in the upper incisors. A Foregger double kettle machine and Fluotec apparatus were employed for delivery of the gases and vapors. Simultaneous distribution of the agents to 4 animals was provided through a manifold connected to transparent plastic masks fitted with valves allowing a nonbreathing system. The voltage necessary to induce minimal chewing or licking responses characteristic for each rabbit was recorded as the threshold. Control levels ranging from 1.5 to 3.5 volts were determined during oxygen inhalation. Thresholds were redetermined after 10 minute periods of breathing successively higher concentrations of drugs. At least 12 animals were studied for each agent; individual animals were used only once. The data were plotted semi-logarithmically as elevations of toothpulp threshold against actual inhaled concentrations. Curves for all agents were characterized by two slopes—a lesser initial and a greater terminal one. The flexures between the two slopes of the curves were associated with changes in the physical appearances of the animals. Threshold elevations along the lesser slopes occurred in apparently alert rabbits presumably in a state of "analgesia"; those along the steeper slopes were recorded in apparently depressed or "anesthetized" animals. Halothane, vinyl ether, ether and cyclopropane were similar in that low levels of threshold increases persisted until concentrations capable of producing apparent "anesthesia" were used. In contrast, trichloroethylene and chloroform induced appreciable threshold increases in apparently alert animals. Comparison of the effects of halothane and chloroform indicated the greater "anesthetic" potency of chloroform. Elevations of threshold did not occur after inhalation of an 80 per cent concentration of nitrous oxide with oxygen for periods up to twenty minutes. An interesting potentiation between nitrous oxide and pentobarbital sodium was suggested by significant increases in thresholds which occurred when "nonanalgesic" doses of both agents were employed. Subsequent research includes investigations of analgesia in nitrous oxide-barbiturate combinations, of relative analgesic potentialities of the various gaseous and volatile agents under equilibrium conditions, and of the predilection, if any, of trichloroethylene for the trigeminal nerve. [*Supported by USPHS Grant B-1079.*]

Resuscitation From Drowning—A Laboratory Evaluation. JOSEPH REDDING, M.D., G. CARL VOIGT, AND PETER SAFAR, M.D. *Department of Anesthesiology, Baltimore City Hospitals, Baltimore, Maryland.* An attempt was made to determine whether water in the lungs, and gastric distension with water hinder resuscitation in dogs. The following modalities were monitored: ECG, breathing movements (pneumograph), pressures in aorta, inferior vena cava and superior vena cava, arterial oxygen saturation and CO_2 content, and hematocrit. *Water in the lungs:* (1) Pilot experiments on 13 awake dogs confirmed the results of others. Direct flooding of the lungs through a tracheotomy tube with fresh water (not with sea water) caused massive absorption of water into the blood stream and ventricular fibrillation in 1 to 2 minutes. In both fresh water and sea water drownings the breathing movements continued until after circulatory arrest; spontaneous recovery occurred, if sea water flooding was stopped before the arterial pressure dropped, and if fresh water flooding did not lead to ventricular fibrillation. (2) Human victims of submersion seem to first develop obstructive asphyxia (laryngospasm), followed by flooding of the lungs and apnea, without immediate cardiac arrest. This condition was simulated by obstructing the tracheal tube of lightly anesthetized dogs (pentobarbital) to the point of apnea. Then the lungs were flooded for 30 seconds either with fresh water (5 dogs), or with sea water (5 dogs), or apnea was permitted to continue for a comparable period without flooding (5 control dogs), and finally resuscitation was attempted with Intermittent Positive Pressure Breathing (IPPB) with air. All control dogs (obstruction without water) survived. Fresh water drowning caused in all dogs mild arterial hypotension,

severe rise in venous pressure, bradycardia, hydremia and hemolysis, followed by sudden ventricular fibrillation in 1–4 minutes after flooding, in spite of IPPB. Sea water drowning caused severe hypotension, slight rise in venous pressure, bradycardia and hemoconcentration and IPPB led to partial reoxygenation of the arterial blood with restoration of the circulation. When IPPB was discontinued after 10 minutes all dogs started breathing spontaneously but died within a few minutes with pulmonary edema. When after sea water drowning in 5 additional dogs, IPPB was performed with oxygen for 3 hours and the trachea was repeatedly aspirated, reoxygenation was better than in the dogs ventilated with air, and foam in the airways disappeared after about 1 hour of IPPB; when IPPB was discontinued after 3 hours, 4 dogs died with pulmonary edema within hours, 1 survived.

Gastric distension: In highly anesthetized dogs (pentobarbital) a gastric latex bag was acutely distended with water (150 cc./kg. body wt.). During spontaneous breathing with normal oxygen saturation (6 dogs) acute gastric distension caused a marked rise in inferior vena cava pressure, no rise in superior vena cava pressure, a slight decrease in mean arterial pressure with a narrowing of the pulse pressure, and no significant change of arterial oxygen saturation. During obstructive asphyxia (tracheal tube clamped) gastric distension produced similar changes in venous pressure, but rise in mean arterial pressure with widened pulse pressure (12 dogs). Obstructive asphyxia was maintained to the point of apnea and resuscitability with IPPB determined. Spontaneous respiratory movements returned more rapidly and the arterial pressure rose quicker when the stomach was drained during resuscitation (6 dogs) than when it was maintained distended (6 dogs). IPPB with fixed tidal volumes reoxygenated the distended dogs as well as the undistended dogs, although higher airway pressures were required in the distended dogs. [*Supported by the Research and Development Division of the Surgeon General, under Contract No. DA-49-007-MD-858.*]

Comparative Evaluation of Three Drugs Used for Sedation, Hypnosis, Amnesia and Narcotic Potentiation During Labor. BENJAMIN ROOT, M.D., EDUARD EICHNER, M.D., MARVIN J. BROWN, M.D., AND MORRIS H. SABLE, M.D. *Departments of Anesthesiology and Obstetrics, Mt. Sinai, Hospital, Cleveland, Ohio.* The evaluation of potent intravenous drugs for pain relief during labor is difficult. Evaluation of drug combinations is performed under conditions unfavorable to objectivity. The use of a single dose for all patients produces too little or too great an effect in a considerable number. Finally, the lack of detailed observation following medication may permit a number of side-effects to remain undiscovered. This study had two main purposes; to develop a technique for objective evaluation of drugs used for medication during labor and to compare two phenothiazine derivatives, promethazine and promazine, with each other and with secobarbital, all being used with appropriate amounts of meperidine and scopolamine.

An obstetric medication evaluation sheet was used to record a battery of reasonably objective clinical observations related to labor, the psychic, hypnotic, and analgesic status of the patient, and vital signs, as well as information about the anesthesia, the baby, and post-partum evaluation. Three drug combinations were administered intravenously in a sequence determined from a table of random numbers in such a manner that the observer did not know their identity until after complete evaluation. The dosages consisted of 50 mg. of each of the phenothiazine with 50 mg. of meperidine, and 100 mg. of secobarbital with 100 mg. of meperidine. All medications included scopolamine 0.4 mg. Subsequent doses of medication were standardized and administered often enough to maintain a satisfactory hypnotic and analgesic effect.

In the first 80 patients studied, the following results were noted. All three medications produced a rather satisfactory degree of hypnosis, analgesia, and amnesia in the majority of patients. Differences in the medications were minor and their significance could not be determined in so small a series. Since equivalent analgesia was provided by the phenothiazines combined with the smaller dose of meperidine, some support was given to the concept of the narcotic-potentiating effect of these drugs.