mechanical ventilation nor did the anesthetic agent used appear to influence the results. These data indicate that a steady state can be maintained in the anesthetized patient with controlled respiration, and that the pulmonary circulatory parameters, investigated in this study, can be maintained in the normal range.

Pulmonary Function Studies Following Intrathoracic Procedures. KARL L. SIEBECKER, M.D., AND T. J. DEKORNFELD, M.D., Department of Anesthesiology, University of Wisconsin Medical School, Madison, Wisconsin.

THERE are relatively few studies reported in the literature regarding pulmonary function in the first week after intrathoracic operations. Therefore, a study was conducted to determine the daily changes in arterial blood oxygen saturation, total vital capacity, and timed vital capacity.

An ear oximeter was used and the vital capacity and timed vital capacity were determined by the method of Curtis, Sadler, and Rasmussen. Twenty-four patients were studied daily for seven days.

The tests done on the second and third postoperative days showed the greatest impairment of function. This was attributed largely to pain, since tests done one hour after administration of adequate opiate showed a 30 to 40 per cent improvement.

A control series is now being conducted regarding these same tests on patients undergoing abdominal operations and operations upon the extremities.

Fluothane—A Preliminary Report. C. R. STEPHEN, M.D., M. BOURGEOIS-GAVARDIN, M.D., L. W. FABIAN, M.D., D. C. GROSSKREUTZ, M.D., S. DENT, M.D., AND J. COUGHLIN, M.D., The Divisions of Anesthesia, Duke University Hospital and School of Medicine and Veterans Hospital, Durham, North Carolina.

AN ETHANE derivative called Fluothane® (CF_3 CHCl Br), a potent, nonexplosive inhalation anesthetic drug, has been synthesized. This drug has a rather pleasant odor resembling either chloroform or trichloroethylene. Its boiling point is 50 C. The compound is stable at room temperatures when kept in light-resistant bottles and can be used safely in the presence of carbon dioxide absorbents. Third stage anesthesia is achieved rapidly with concentrations of one to two volumes per cent in the inhaled mixture. Recovery from anesthesia is swift and usually devoid of nausea and vomiting.

Our investigations reveal induction to be feasible by the open drop technique or by vaporizing the drug with oxygen alone or with nitrous oxide-oxygen. A short excitement stage lasting one to three minutes occurs usually unless premedication is very effective or a hypnotic dose of a barbiturate has been given. The respiratory signs of anesthesia—progressive intercostal lag and paresis with increasing blood concentrations—are similar to those seen with ethyl ether, although they progress at a much more rapid rate. The drug is nonirritating to the respiratory tract and does not stimulate salivary secretions.

The pulse rate changes little with increasing depth of anesthesia. A progressive hypotension occurs with inhalation of high concentrations of the drug and becomes profound in some animals with extreme rapidity. When hypotension is recognized early, it is reversible by lightening the plane of anesthesia or by injection of a vasopressor compound. The cause of hypotension is unknown.

Cardiac arrhythmias have occurred in animals and man. Nodal rhythm, premature auricular and ventricular contractions, bigeminal rhythm and multifocal ventricular extrasystoles have been recorded. These arrhythmias have reverted spontaneously with lightening of anesthesia.

Fluothane can be used safely with anticholinergic compounds (atropine) ultrashort-acting barbiturates, narcotics (meperidine) and with the depolarizing type of muscle relaxant drugs (succinylcholine). The combination of Fluothane and the myoneural blocking relaxants (*d*-tubocurarine chloride) in dogs produces a profound hypotension which sometimes is irreversible. The vasopressor action of the sympathomimetic drugs is unaffected by Fluothane, but the drug does increase the sensitivity of the heart to those

amines which have a direct cardiac action. In dogs ventricular arrhythmias can be instigated by the injection of ephedrine and norepinephrine, while the injection of a relatively large dose of epinephrine produces ventricular fibrillation.

Histological studies on seven dogs and two monkeys exposed to anesthetic concentrations of Fluothane for a total of 24 hours over a period of six days have revealed changes only in the liver. In hematoxylin-eosin stained slides, there was a pallor about the central vein of the liver lobules. No cellular destruction was apparent.

To date Fluothane has been employed as the principal anesthetic drug in 145 patients undergoing surgery. Four to six minutes after beginning anesthesia, sufficient relaxation was present to perform endotracheal intubation. A moderate fall in blood pressure (30 to 40 mm. Hg) was seen during induction in about 50 per cent of patients. This corrected itself within 10 to 20 minutes, and the blood pressure was maintained usually about 10 to 20 mm. Hg below the preoperative level. Respiratory depression occurred frequently. Almost all patients have been monitored with the electrocardiograph, and in ten (6.9 per cent), cardiac arrhythmias, readily reversible by lightening anesthesia, have been noted. The depth of anesthesia could be altered in three or four respirations. Recovery from anesthesia has been rapid and remarkably benign. Complete mental orientation has occurred in all patients within 30 minutes of termination of anesthesia. Nausea has occurred in 4 patients (2.7 per cent) and vomiting in 8 patients (5.5 per cent). Bromsulphalein dye tests done in 18 patients showed in 14 patients a retention of 8 to 39 per cent in 24 hours, but no retention in any patients five days postoperatively. Blood sugar estimations performed during operation in 17 patients showed no significant elevation.

Circulatory Arrest in Patients with Complete Heart Block During Anesthesia and Operation. LEROY D. VANDAM, M.D., AND GEORGE A. MCLEMORE, M.D., Division of Anesthesia, Department of Surgery and the Medical Clinic of the Peter Bent Brigham Hospital, Harvard Medical School, Boston, Massachusetts.

CARDIAC arrest during anesthesia is usually unexpected except perhaps in patients undergoing operation on the heart. The cardiac patient operated on for other conditions usually fares well in this regard. Recently, however, we have witnessed several episodes of cardiac arrest in patients with heart block. This has led us to review the previous anesthetic experience with this type of heart disease. The discovery of an inordinate number of arrests indicates that circulatory arrest should be anticipated in this group of patients and that the means for prevention should be investigated further. Circulatory rather than cardiac arrest is the better term since it has been shown that asystole, ventricular tachycardia or fibrillation may be the primary event.

The records of twenty-two surgical patients with established complete heart block were studied. The group comprised patients in the older age groups with coronary sclerosis or hypertension the usual underlying heart disease. Twelve had Adams-Stokes attacks prior to operation. Fifteen of the operations were major with cholecystectomy accounting for seven. Diethyl-ether was the principle agent for most of the major operations while local anesthesia predominated in the minor procedures. It is a striking fact that six of the twenty-two patients had two or more episodes of circulatory arrest during anesthesia and operation. Fortunately there were no fatalities and emergency thoracotomy was performed in only one case. In retrospect the thoracotomy need not have been done. The circumstances surrounding the circulatory arrests are illuminating.

Five of the six patients with arrest had had Adams-Stokes attacks that had not responded to the usual measures. Adrenalin, sympathomimetic amines, atropine, thyroid, barium and ammonium chloride were ineffective in preventing attacks. Five of the patients underwent major operations and cholecystectomy was accomplished in four. Cholecystectomy has been suggested as a therapeutic measure for the relief of Adams-Stokes disease when a relation to gall bladder disease seems likely. Atropine in doses up to 0.6 mg. for preoperative medication failed to protect against arrest. There is reason to believe that larger doses would have been equally ineffective. The depressant