dynamic compliance. *Results:* The average dead space to tidal volume ratio was 0.65, with range of 0.38 to 0.80. For any particular patient the dead space to tidal volume ratio was almost constant regardless of any change in tidal ventilation. As tidal ventilation was increased above 15 ml./kg. body weight, there was a significant ($P < 0.01$) decrease in cardiac output and stroke index in the 4 patients with emphysema, but in the other patients cardiac output was little affected. All of 21 measurements of the dead space to tidal volume ratio in the patients with emphysema were above 0.55, while the physiologic shunt in the emphysematous patients averaged 10 per cent of the cardiac output. In the 8 patients without emphysema the physiologic shunt ranged from 6 to 79 per cent of the cardiac output, shunts above 30 per cent being associated with dead space to tidal volume ratios of over 0.65 in each of twelve measurements. A significant ($P < 0.02$) positive correlation existed, when all 12 patients were considered, between changes in stroke index and changes in the percentage of the cardiac output which flowed as physiologic shunt, but no correlation could be found between stroke index and dead space to tidal volume ratio. Total dynamic compliance ranged between 0.0129 and 0.0463 liters per cm. water, there being no correlation between total dynamic compliance and the size of the tidal volume in patients without emphysema. However, in the patients with emphysema the total dynamic compliance (range 0.0104 to 0.0275 liters per cm. water) was affected by the size of the tidal volume, there being a significant ($P < 0.01$) increase in total dynamic compliance as tidal ventilation was increased. When the tidal volume was decreased below 15 ml./kg. body weight, the physiologic shunt increased twice as often as it decreased. When tidal volumes greater than 15 ml./kg. body weight were employed the physiologic shunt was decreased twice as frequently as it was increased. (Supported by Grant HE 08558-03 from the U.S.P.H.S.)

Influence of Vasoexcitor Drugs on Reticuloendothelial Phagocytic Function in Experimental Shock. S. G. Hershey, M.D., and B. M. Altura, Ph.D., *New York University Medical Center, New York City.* Tissue perfusion mediated via the exchange vessels of the microcirculation is generally regarded as a critical factor in the pathogenesis of shock. Extensive data indicate that microcirculatory insufficiency can be avoided by direct therapy which modifies the vasomotor behavior of the terminal vascular bed. It can also be prevented by pretreatment which modifies tissue responses which normally contribute to the development of peripheral circulatory failure. Our laboratory explored the direct therapeutic approach by means of vasoactive drugs which exert selective effects on the vessels in the micro-bed and the indirect prophylactic approach by materials which stimulate reticuloendothelial system (RES) activity. *Method:* To help correlate both of the above approaches a dual stress type of shock (in rats) was employed in which an initial, relatively nonlethal episode (80 per cent survival) of intestinal ischemia (SMA) was followed 24 hours later by an episode of acute hemorrhage (3 per cent body wt.) which, *per se,* is relatively nonlethal (83 per cent survival) but results in high mortality (55 per cent) in the dually stressed animals. This type of experimental shock simulates the clinical situation in which patients successfully tolerate an initial stress (operation, trauma, blood loss) but are unable to cope with a relatively lesser stress (postoperative complictaion) subsequently superimposed during the early recovery period. In the dually stressed rats vasoactive drug therapy (norepinephrine, angiotensin, PLV-2) was instituted 10 minutes after hemorrhage for 1 hour, and 20 minutes afterward the shed blood was reinfused. RES indices were derived (method of Biozzi) by determining blood clearance of colloidal carbon at 3 and 24 hours after SMA and hemorrhage separately and when the latter succeeds the former (dual stress). *Results:* The data, thus far, indicate that RES activity is depressed after SMA and hemorrhage as separate stresses for at least 24 hours even though the animals appear entirely normal. After dual stress, early, the RES index is markedly reduced in all rats, but in survivors, after 24 hours, the RES index is markedly increased regardless of the therapy used. Survival rates in controls (saline), norepinephrine and angiotensin treated groups are

comparable. PLV-2 therapy results in significantly higher (1 per cent level-chi sq.) survival. *Conclusion:* The findings that RES activity correlates as both a diagnostic and therapeutic parameter of host responses at a tissue level suggest the potential therapeutic value of exogenous stimulation of the RES in shock. (Study aided in part by U.S.P.H.S. Grant HE-09042.)

Dead Space During Controlled Ventilation. MYRON B. LAVER, M.D., BERTIL LÖFSTRÖM, M.D., HARTMUT HEITMANN, M.D., and HENNING PONTOPPIDAN, M.D., *Anaesthesia Laboratory of the Harvard Medical School and the Respiratory Unit at the Massachusetts General Hospital, Boston.* The present study was undertaken to define the relation between physiological shunting and dead space during controlled ventilation. *Method:* Data were collected from 23 anesthetized and paralyzed mongrel dogs (9–25 kg.) ventilated with pure oxygen. Physiological dead space in the presence of physiological shunting was calculated from the Bohr equation, using a mean alveolar P_{CO_2} obtained from the *in vivo* CO_2 dissociation curve and solution of the shunt equation with the CO_2 content data. Various degrees of venous admixture were produced by suction of air from the airway. Measurements were made after the animals had been maintained on constant volume ventilation at a particular tidal volume, for a period of 30 minutes. Changes in the state of expansion of the lungs were produced by either increasing the tidal volume or by repeating the deflation maneuver. The functional residual capacity was determined with a whole body plethysmograph. The cardiac output was calculated by the Fick principle using the CO_2 data. There was a consistently small arterial-alveolar P_{CO_2} difference ranging from zero to 2.5 mm. of mercury when the Q_S/Q_T fraction was less than 10 per cent of the cardiac output. The P_{CO_2} gradient increased significantly ($P < 0.01$) to a maximum value of 10 mm. of mercury as the Q_S/Q_T rose to 60 per cent of the cardiac output. The calculated regression equation for the $a\text{-}AD_{CO_2}$ on Q_S/Q_T was $y = 0.72 + 0.08x$. *Results:* The physiological dead space, determined either with the Bohr or Enghoff equation, showed no change over a range of tidal ventilation that resulted in venous admixture which varied from 10 to 60 per cent of the cardiac output. Although the absolute value of the physiological dead space (Bohr): 23.6 ± 9.9 ml./kg. body weight was insignificantly higher with a low $Q_S/Q_T \times 100$ (7.5 ± 1.7 per cent) than at higher degrees of venous admixture [$Q_S/Q_T \times 100 = 14.3 \pm 2.4$ per cent and physiological dead space (Bohr) $= 9.4 \pm 3.7$ ml./kg. body weight] there was no significant alteration in the dead space to tidal volume ratio (V_D/V_T). There were no significant changes in the cardiac index, functional residual capacity, and CO_2 output as the tidal volume varied from 8.5 ± 0.72 to 52.3 ± 8.54 ml./kg. body weight. The large tidal volumes were associated with the lowest shunts ($Q_S/Q_T \times 100$) and the highest arterial oxygen tensions (Pa_{O_2}). Use of the term dead space does not seem appropriate when describing the effects of large tidal volumes in the normal lung. Changes in arterial to alveolar carbon dioxide tension do occur, but there is no evidence to suggest a reduction in the effectiveness of ventilation. The $Q_S/Q_T \times 100$ was maintained below 10 per cent of cardiac output with tidal volumes above 12.8 ± 2.95 ml./kg. body weight. *Conclusion:* Clearly, during controlled ventilation large tidal volumes are required in order to maintain maximal oxygenation. (Supported by NIH grant number HE 09340-01.)

Observations on Fetal Electrocardiographic Responses to Hemodynamic Influences. ELIA LIPTON, M.B., CH.B., FRANCIS W. SENNOTT, M.D., and BERNARD BATT, M.D., *St. Margaret's Hospital, Boston.* This study was prompted by clinical experiences involving possible influences on fetal heart rate of maternal hypotension and/or maternally administered vasopressors. *Methods:* The effects on the fetal heart rate of intravenously injected single doses of methoxamine (4 mg.), phenylephrine (washings) and mephentermine (15 mg.) were studied in both normotensive and hypotensive parturients. Fetal heart rates and patterns were continuously monitored with a Telemedics RKG 500 remote recorder system. Improved noise-free tracings were obtained with two abdominally applied German silver electrodes. The patients under observation were selected entirely from mothers in the