A meeting of the Medical Research Society was held at the University College Hospital, London, on 20 March 1970. The following Communications and Demonstrations were given:

COMMUNICATIONS

1. THE MARRIAGE OF FICK AND BOHR ARRANGED BY COMPUTER

S. GODFREY
Institute of Diseases of the Chest, Fulham Road, London, S.W.3

In a steady state the rate of removal of CO₂ from the blood into the alveoli equals its rate of removal from alveoli to atmosphere. There is a gradient of CO₂ concentration from mixed venous blood to alveolar gas or arterial blood and then to mixed expired gas. The mixed venous to alveolar (or arterial) difference depends upon cardiac output (Fick) and the alveolar (or arterial) to mixed expired difference depends upon physiological dead space (Bohr). Mixed venous CO₂ tension (rebreathing), mixed expired CO₂ tension and CO₂ production can easily be measured. If an arbitrary value for arterial CO₂ tension is selected the simultaneous equations for cardiac output and dead space may be solved, and if this process is repeated coordinates may be obtained relating cardiac output, dead space and arterial CO₂ tension.

A digital computer can be programmed to construct a graph relating cardiac output, dead space and arterial CO₂ tension for any given CO₂ production, mixed venous and mixed expired CO₂ tension. It is able not only to convert CO₂ tensions into the required concentrations but also to make allowances at all stages for alterations in the CO₂ dissociation curve due to such factors as saturation, base excess and haemoglobin.

2. RELATIVE HYSTERESIS OF AIRSPACES AND BRONCHI IN EXCISED LUNGS

J. M. B. HUGHES, F. H. HOPPIN, Jr and J. MEAD
Department of Physiology, Harvard School of Public Health, Boston, U.S.A.

Hysteresis of lung tissue is well known: at the same lung volume in excised lungs transpulmonary pressure (TPP) may be 2-8 cm H₂O greater after inflation from a low volume than after deflation from maximal volume. Such hysteresis of air spaces depends principally on the presence of a layer of lung surfactant lining the airspaces. Conducting airways, structurally different and lacking surfactant, might be expected to show a different hysteresis relative to that of the airspaces. Measurements of the anatomic dead space in man (Froeb & Mead, 1968, Journal of Applied Physiology, 25, 244-248), suggested that airway hysteresis was similar to or slightly greater than lung hysteresis. We report here direct measurements of airway volume changes from bronchial length and diameters.

Bronchi down to 2 mm diameter were outlined with tantalum dust in excised dog lungs. Stereoscopic X-ray pairs were taken at different lung volumes and TPP, and bronchial lengths and diameters computed from the films. At full inflation bronchial segments averaged 1.75 cm in length; diameters ranged from 1.7 to 0.3 cm. Over the range 30-33 cm H₂O TPP, the changes of bronchial length and in most cases, of diameter also (as a percentage of maximum) were proportional to the cube root of absolute lung volume changes. With regard to relative hysteresis, at the same lung volume but at TPPs which differed by 2-7.5 cm H₂O due to an inflation or deflation volume history, all bronchial lengths and diameters were similar.

The correlation of bronchial length with lung volume was expected and suggests that shear stress between airways as they lengthen and lung tissue is probably small. In addition the findings suggest airways in excised lungs may have intrinsic properties which result in their diameters having a similar hysteresis to that of air spaces.

3. FLEXIBILITY OF RED CELLS AND PRESSURE–FLOW RELATIONS IN ISOLATED LUNGS

R. E. GREENE, J. M. B. HUGHES, L. D. ILIFF and G. F. PINEO
Respiratory Research Group, Department of Medicine, Royal Postgraduate Medical School, London, W.12

Red cells are normally flexible and have been shown to reversibly deform in the microcirculation. Under certain conditions red cells may become less compliant and this should in theory increase resistance to flow. The present study investigates the effect of diminished red cell flexibility on pressure–flow relations in lungs.

We heated blood at 49° for 1 hr and found the red cells to be relatively inflexible using the centrifugal packing rate as a flexibility index. Measurements were made of blood flow, pulmonary arterial, venous and transpulmonary pressures in twelve isolated dog lungs perfused with heparinized blood at 37°. After control measurements the blood in the perfusion circuit was exchanged for previously heated blood and pressure–flow measurements were again made. A final control