As part of our Centenary Year celebrations, we will republish landmark papers and reflections from our archives. This issue we present the editorial for 1 August 1953, in which breakthroughs in the development of an artificial heart are discussed.

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ARTIFICIAL HEART.

To devise a double pump which could produce something like the normal systemic and pulmonary circulations has long been a dream of the physiologist and, since the rise of thoracic surgery, a dream of the surgeon. The difficulties have been great; one is to prevent coagulation of the blood; another is concerned with the fact, very early perceived by Starling, that the lungs do more than aerate the blood, as some subtle changes in the cellular contents are invariably present when the real pulmonary circulation is omitted. Then a pump which will drive the blood forward without causing hæmolysis is not easy to construct; also the blood to be equilibrated must not be bubbled as J. S. Haldane and Joseph Barcroft forcibly pointed out. Another difficulty is the delicate adjustment, discovered by Haldane, of the amplitude of aeration in the lungs based on the carbon dioxide partial pressure in the arterial blood in contact with the respiratory centres; attempts to surmount this have been made by B. J. Miller, J. H. Gibbon and M. H. Gibbon.[1] One improvement in technique after another has been made with valuable contributions from Crafoord and Björk in Sweden, Kolff and Jongbloed in Holland, André Thomas in France, Leland Clark in America and Tyrer in Australia, until, as D. G. Melrose states in the article about to be discussed, "the stage is almost set for clinical use". The most recent attack on the problem will be found in two articles, one entitled "Experimental Physiology of a Heart-Lung Machine in Parallel with Normal Circulation" by D. G. Melrose, J. W. Basset, P. Beaconsfield, L. G. Graber and R. Shackman, the other "A Mechanical Heart-Lung for Use in Man", by D. G. Melrose, with a foreword by Ian Aird, both appearing in the *British Medical Journal* of July 11, 1953. This research has taken some four years to conduct, and the presentation displays evidence of exceptional attention to detail with the recognition of possibilities of going wrong and the methods to prevent such happenings. Dr. Melrose with commendable caution comes to the conclusion that a heart-lung machine to replace the heart and lungs of a patient subjected to cardiac surgery presents difficulties in design and working too great at present to overcome, and so he has, with his associates, fallen back on a heart-lung mechanism in parallel with the existing circulation and so capable of being described as "assisted circulation"; that is, an adjustable fraction of the total blood can be sent through an aerating device and returned with the correct carbon dioxide and oxygen partial pressures and consequently the correct quantities of each. The Dale-Schuster instrument for pumping was already on the market manufactured by C. F. Palmer, the physiological instrument maker, but Melrose preferred another device for the two pumps, employing with each a valveless elastic tube containing the blood and squeezed by the action of a roller. He soon found that, if the squeezing process was too vigorous, hæmolysis occurred, and therefore the "pump" was designed so that the lumen was just obliterated by the pressure of a cam without any shearing stress; thus injury to the erythrocytes was prevented. The new oxygenator employed was a rotating cylinder with a slight tilt; blood flowed by gravity from one end to the other and was spread over a multitude of surfaces formed by blades projecting into the lumen of the cylinder. Each pump was capable of delicate adjustment to prevent accumulation of blood in any one circuit. In the animal experiments heparin or dextran sulphate was given to prevent clotting. The tubing and catheters were made of polyvinyl chloride, which is not wettable with the blood and so inhibits clotting. It is interesting to note that this same substance was employed for a similar purpose by John J. Osborn, of the New York University College of Medicine.[1]

No doubt considerations of space prohibited Dr. Melrose and his collaborators from giving a full bibliography and critical commentary concerning his predecessors, but many readers will regret that no mention is made of the researches of Dr. J. H. Tyrer, of the University of Sydney, whose paper, "The Peripheral Action of Digoxin on Venous Pressure: A Study Using Sheep with an Artificial Heart", appeared in THE MEDICAL JOURNAL OF AUSTRALIA on April 12, 1952. Dr. Tyrer's purpose in devising an artificial heart was to remove the cardiac factor completely in the investigation of the alterations in venous pressure produced by digitalis. Dr. Tyrer showed conclusively that in the sheep with the heart out of action digoxin produced a rise of venous pressure, thus proving peripheral action of the drug. Before he could put this proof to the test he had to devise a double pump "heart" and an aerating mechanism. He used the Dale-Schuster pump already referred to, an instrument manufactured by C. F. Palmer. It is possible that many who have some experience in such matters will prefer Dr. Tyrer's oxygenator to the complicated mechanism invented by Dr. Melrose, for in this oxygenator the blood is spun into a thin film on the inside of a "Perspex" chamber and flows down this in contact with a mixture of 95% oxygen and 5% carbon dioxide. In this apparatus there will be less agitation of the blood and consequently less hæmolysis. The eventual goal of getting a temporary circulation of artificial character and allowing the surgeon to operate on a heart containing no blood in its chambers is coming nearer, and success may be early expected.

[1] *Ann. Surg.* (1951), 134 : 694.

[1] *Science*, May 15, 1953, 537.