

Cournand A, Motley H L, Werko L & Richards D W. Physiological studies of the effects of intermittent positive pressure breathing on cardiac output in man. *Amer. J. Physiol.* 152:162-74, 1948.
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The effects of three types of intermittent positive pressure breathing (IPPB) were correlated with changes in cardiac output in 29 human subjects with essentially normal circulation. The results suggested that the deficit in cardiac output incurred during the inspiratory phase is compensated for during the expiratory phase. The parameters of a highly desirable type of IPPB for artificial respiration were proposed. [The SCI® indicates that this paper has been cited in over 440 publications since 1955.]

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I have always been very proud of the studies described in this paper because I generated the ideas from which the studies were implemented. But these ideas did not arise in a historical vacuum, nor could they have been carried out without my interaction with Dick Richards, the intelligence of Lars Werko, and the hard work of Hurley Motley.

A long line of investigators had already identified the important questions that needed to be answered with regard to the relation between the lungs and heart output. With my French background I was particularly aware of the work of Claude Bernard, who had catheterized horses and measured venous and arterial blood temperatures. Richards's roots were firmly implanted in the work of L.J. Henderson, whose classic book, *Blood: A Study in General Physiology*,¹ was published several years before I came to the US in 1930.

In order to complete my specialization in pneumonology, I came to the Chest Disease Service of Bellevue Hospital, then a section of the Columbia University Division. As a resident I was under the head of the service, James Alexander Miller, who asked me in 1931 if I would

like to collaborate with Richards in establishing a laboratory for the investigation of the influence of thoracic surgery and pulmonary disease on pulmonary physiology. My experience with lung disease and Richards's background in pulmonary physiology helped to bring about the development of pulmonary clinical physiology.

Our program intent was to define the various functions involved in the transport of respiratory gases through the lungs and to evaluate and standardize the methods used for their measurement—in brief, to build a battery of techniques for routine use. The limitations and ambiguous results of earlier techniques for the collection of mixed venous blood in the right heart cavities eventually led to the development of cardiac catheterization used to study a large number of relations between breathing and cardiac output. Thus, the study of pulmonary circulation entered the domain of clinical physiology in a routine way. Following our study of 125 cases of clinical shock induced by severe trauma, surgeons and physicians were persuaded that such studies involved minimal risk and resulted in valuable gains in basic concepts and understanding of indications for treatment.

The Nobel Prize in medicine and physiology was awarded to Richards and me in 1956. The prize is given to those scientists whose discoveries open new possibilities in the world of medicine. This was certainly true in our case, as the cardiac catheter and our methods of study are used extensively in every important medical center in this country and abroad.

After my retirement, I became interested in the social and ethical aspects of science, which I described in my recent book, *From Roots to Late Budding: The Intellectual Adventures of a Medical Scientist*.²

1. Henderson L J. *Blood: a study in general physiology*. New Haven, CT: Yale University Press, 1928. 307 p. (Cited 165 times since 1955.)
2. Cournand A F & Meyer M. *From roots to late budding: the intellectual adventures of a medical scientist*. New York: Gardner Press, 1986. 232 p.