The estimation of the part played in respiration by the various muscles has enjoyed the attention of anatomists from the earliest times; even before the time of Galen it was discussed, and the action of the diaphragm was fairly well understood.

Galen himself made a long series of experiments on animals, in some of which he cut the nerves to the intercostals, cutting through pectorals, serrati and scaleni, and concluded that this great muscle pulled the lower ribs upward and outward. Vesalius, who usually lost no opportunity of combatting any view of Galen, admitted this action, and called it a muscle of inspiration, but claimed that in this part of the respiratory cycle it went up into the thorax and pulled the ribs up with it. His own words are, "the movement of elevation and expansion of the diaphragm is so evident in vivisection, that the muscle pulls itself up into the cavity of the thorax and draws after it the liver and the stomach."

The true mechanics of the diaphragm were worked out by Duchenne of Boulogne, who by electrical stimulation of the phrenic nerves in the neck showed its action to be the raising upward and outward of the lower ribs and the lowering of the thoracic floor, increasing its lateral diameter to a very considerable extent, and its antero-posterior diameter but very slightly. He found that if the animal were eviscerated the muscle pulled the ribs downward and inward, and hence he concluded, that the abdominal viscera give a solid point d'appui for its action in raising the ribs in inspiration. Beau and Massenet had previously concluded that the pericardium furnished the fixed point for this action of the diaphragm on the lower ribs.

The elevation and outward rotation of the upper ribs as proved by Duchenne's experiments, is due to the action of the intercostal muscles both acting in inspiration, and each pair acting on the inferior rib from the one above; the fixed point being the first rib, which is connected with the vertebra by the scalene muscles and to the cranium by the sterno-mastoid. These muscles do more than fix the upper ribs, for in forced inspiration the upper end of the sternum is raised from 1 to 1½ inches, a very remarkable variation, when we consider the influence that would have on the slant of the lower ribs.

As we pass downwards we find the direction of the ribs becomes more and more oblique and their length increases up to the 8th or 9th. The lower end of the sternum is also much farther from the spine and in forced inspiration its lower end is projected forward about an inch. As Duchenne's experiments showed that the diaphragm alone had little influence in projecting it forward, we must conclude that this change of position is due to the general raising of the thoracic wall,