

THE HISTORY OF OUR KNOWLEDGE REGARDING
THE FUNCTIONS OF THE LUNGS.

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Every constituent cell of vegetable or animal tissue must respire, if it is to live. In the simplest unicellular forms of life respiration is by exchange of gases, by diffusion, from within and without the cell. Lung structure is therefore not essential for respiration. The tubular breathing systems in the Insect Group obviate the necessity of Lungs in these forms of life. The System of Gills in the fishes, with an afferent and efferent vascular connection, marks a further evolutionary development, until in the higher animals and man we find true Lungs into which air enters, and from which air is forced, with the regular expansion and contraction of the Lung tissue. Wherever Lungs are present we find a highly developed associated blood vascular system for the purpose of effecting gaseous exchange.

In the light of modern Physiology, we are able to ascribe many important functions to the Lungs, such as the excretion of CO_2 , the oxygenation of the blood, the regulation of Blood chemistry, the liberation of excess moisture, control of the Body temperature, and so on, and that the particular Lung activity is governed by a complex series of factors, being interdependent with the state of activity of other body systems. The most popular conception of Lung function to-day is that the Lungs serve to admit fresh air to the body and to expel foul or used air. It is also universally realised that Lung function is almost wholly necessary for continuance of Life, and that if breathing is stopped, death is likely to ensue.

This popular idea may have given rise to the adage "dum spiro, spero". The idea that the breathing of air constituted Life is of no modern origin. Indeed, the first Literary Reference to this concerns affairs of 4,000 years B.C., when we read in Genesis 2.7. "And the Lord formed man of the dust of the ground, and breathed into his nostrils the Breath of Life; and man became a living soul". This text suggests the principle that Life of the Body necessitates the act of Breathing, and that such breath makes man a living soul. This idea savours of that which was prevalent in the Egyptian period, as seen in Egyptian art and sculpture; that the Spirit entered the Body at birth, and left it at the moment of death, the Spirit of Life being depicted as a bird. There is here an undoubted attempt to symbolise the soul which dwells within the animate being, and which leaves the bodily form when life is extinct, the soul being immortal.

The divine influence over Life and Breath is reiterated in the Scriptures of later periods as in Job XII.

"Who knoweth not in all these, that the hand of the Lord hath wrought this? In whose hand is the Soul of every living thing, and the breath of all mankind".

Or in the words of the Psalmist - Psalm 114. "Thou hidest thy face, they are troubled; thou takest away their breath, they die, and return to their dust".

The New Testament writer acknowledges God's gift of breath, and the necessity of such a gift for Life.

Acts.XVII.25. "God..... giveth to all Life, and Breath, and all things".

While it was recognised, from the earliest of Biblical Records, that the act of breathing was a God-given necessity, nevertheless man soon contrived to deprive his fellows of the gift of Life, by arresting Lung function, in order to gain his own ends. Thus in II.Kings, VIII. we have surely the earliest recorded case of Homicidal suffocation.

"And it came to pass on the morrow that Hazael took a thick cloth, and dipped it in water, and spread it oved Ben-hadad's face, so that he died; and Hazael reigned in his place".

Turning from the early Biblical conception of Breath as the "sinequa non" of Life, we find an advance in the ideas of Lung function in the Nei Ching, the Canon of Medicine traditionally ascribed to Huang-Ti, 2600 B.C. This work describes the Lungs as "the ministers who regulate one's actions". This vague statement in itself makes little contribution to the knowledge of Lung function, but the Nei Ching goes further than this. It has been claimed that Harvey's epoch-making discovery had been anticipated in China by about 2000 years. This assumption is based upon rather scanty evidence, nevertheless it must be admitted that the ancients made a very near guess at the facts as the following passage from the Nei Ching suggests:-

"The Blood travels a distance of 3 inches during inhalation; and another 3 inches during exhalation, making 6 inches in one Respiration"¹.

The Systemic and Pulmonary Circulations were not understood, but the statement that the Blood travels 6 inches on Respiration is remarkable in that it points to an early attempt at experimental Physiology. Such experiment does not appear to have been followed up, and it is in Greek medicine that we find physiological suggestions put forward, with little or no experimental basis. Thus, Empedocles of Agrigentum 504-443 B.C., representing the Pythagorean School of Medicinal Thought taught that fire, air, water, and earth were the four elements and that the human body, compounded of these, was in health when they were in equilibrium, and in disease when they were disproportioned.^{2.} Later, Praxagoras of Cos, of the Dogmatic Greek School, c. 330 B.C., taught that the Arteries originated in the Lungs and ended in the Nerves. Despite the fact that so little was known of the physiology of the Lungs, diseases of the Lungs were recognised and treated.

Callius tells us that Herophilus (300 B.C.) maintained that it was the Lung that was diseased in Pleurisy, while Asclepiades (100 B.C.), Diocles (350 B.C.), Erisistratus (260 B.C.) and his disciples taught that the site of the disease was the Pleura. In the therapeutics of the Pulmonary diseases, Hippocrates (460-377 B.C.) advised inhalations for the pain, blood letting from the arm, and emollient applications. Diocles advised Blood letting, and dietetic measures. Praxagoras - prescribed an emulsion of Pepper, vinegar, and wormwood. Asclepiades advised Bleeding, no purgatives, but enemata, free

drinks and liberal food.^{3.}

While the Methodists were incapable of giving a definition of Pneumonia, Asclepiades described the condition as an effluxion with fever, with an acute development, accompanied by tumefaction of the chest. Later, Soranus of Ephesus (98-117) defined the disease as a violent and acute constriction of the Pores of the Lungs, with sputum, thirst, and temporary fever, anorexia, pain in the side, congested eyes and cheek-bones, dyspnoea with superficial and distressed breathing. It is curious to note the different opinions as to the seat of the inflammatory process in pneumonia. According to Diocles it was the Pulmonary Veins; Erisistratus stated it was in the Arteries. Praxagoras said that the Posterior part of the Lung was the seat, while Herophilus said the entire Lung was diseased. Asclepiades held that it was in the Bronchial Tubes. Apollonius considered the affection to arise in both artery and vein. To Soranus, at a later day, is due credit for maintaining that it was a general disease with a Pulmonary Localisation. Caelius, 400, writing on the Symptoms of Pleurisy, states, "Mentis alieno, gutturis stridor, et sonitus interuis resonans aut sibilans in ea parte quae patitur"^{4.}, suggesting that Laennec was not the first to listen to the chest in this disease.

The attention, given by the Greeks, to diseased conditions of the Lungs was carried on, and manifests itself in the records of Islamic Medicine, when Physicians noted increased Respirations and terminal asphyxia in such conditions as

Meningitis. Avicenna⁵ (980-1037) in his "Canon of Medicine" has given a good description of Affections of the Respiratory apparatus. He differentiated Pleurisy from inflammation of the intercostal muscles or mediastinum, and from abscess of the upper surface of the Liver, and points out that an inflammatory process may spread from Liver to Pleura. More advance in knowledge of Lung function in health and disease might have occurred at this time but for the fact that Mahometans were prevented from making autopsies, by Religious Scruples; hence little progress in Anatomy and Physiology occurred. An operation to overcome Respiratory obstruction, at this period, is worthy of note. Abulcasis (936-1013) performed a Transverse Tracheotomy between the third and fourth Tracheal Rings in a female case of Diphtheria, with rapid recovery resulting.

Galen (130-200), in Physiology dealt with the Systolic and Diastolic movements of the heart, and seems to have some idea of the Pulmonary circulation when he states that of the vessels one starts from the left cavity of the heart, one from the right, and one from the Pharynx. He described the vascular network of the Lung, with interstices packed with soft tissue.⁶ A more definite description of the Pulmonary Circulation is given by Servetus⁷ who insisted on the communication of the Pulmonary Artery and Veins; that, through them the Blood took its course from the Right to the Left side of the Heart; that the Blood Pervaded the Lungs, not merely for the nutrition of that part of the Body, but for the purpose of being elaborated and attenuated

by a spirit inspired from air, and the emission of a fuliginous matter in expiration. "Had these latter assertions resulted from experiment, instead of being the offspring of ingenious hypothesis, what an important advancement towards the doctrine of the immortal Harvey had been ascribed to Servetus"^{8.} (1511-1553). Previous to the description by Servetus of the Pulmonary Circulation it was thought that Blood passed through the Septum of the Heart. In an age of experimental method revival, Harvey^{9.} (1578-1657) in his "Exercitatie" observed the pulsation of the Pulmonary Artery, and in his doctrine of circulation recognised that a circulation of Blood occurred from the heart to the Lungs, and back to the heart. Harvey's discovery ended the usefulness of the Theory of Galen, which, through so many Centuries, had enlightened the minds of Physicians; at the same time it restored the methods of the Greeks to their former consideration, and enjoined upon all that necessity of reverting to "the study of Nature upon which Galen and Hippocrates had dwelt insistently."^{10.}

While the suggestions of Servetus and the experiments of Harvey indicated the nature of a Pulmonary circulation, we find prior to this time the continuance of the Galenic Doctrine. Vesalius, in his "Structure of the Human Body" was content to teach Galenic Doctrine, teaching that air was drawn from the Lungs to the heart through the vein - like artery, and used for cooling the innate heat, for the nourishment of its substance, and for the preparation of the vital spirits; the air mingling with the blood which passes through the Septum from the Right

Ventricle to the Left, and so by way of the Aorta to the whole Body. Vesalius (1543) accommodated his statements to the dogma of Galen, because he hesitated to lay down his own opinions, "and did not dare to swerve a nail's breadth from the doctrines of the Prince of Medicine"¹¹. Despite this, Harvey's great work was the direct outcome of Vesalius' teaching. Fabricius, too, in his teaching (1599) in the treatise "De respiratione et ejus instrumentis" makes little or no reference to Vesalius' anatomical work. The Galenic doctrine is fostered in Fabricius' teaching for in breathing, he says, "Nature puts before herself mainly a double goal, the generation of the animal spirits, and the regulation and conservation of the heat of the heart". He hints at gaseous exchange in respiration.

The Physiology of the Lungs was advanced considerably during the Seventeenth Century by a series of experimenters, after a long period when medical knowledge was at a standstill. Van Helmont (1577-1644), half a century after Paracelsus formulated his theory of the three elements, based his exposition of Physiology on a theory of fermentations, and explained aeration of blood as a process of fermentation. Borelli (1608-1679) dealt with the problem from the mechanical and physical aspects, and Boyle (1627-1691) likened the process of breathing to that of burning. In 1624 a German-Italian physician, John Faber, proved by insufflation that the air did not pass from the Lungs to the vessels, and this discovery was of use to Harvey. Van Helmont had already upheld this theory, and pointed out that

the air passed through the Lungs as if they were a seive, and that the Pulmonary cells were endowed with a motor force, although the act of respiration was above all accomplished by the muscles of the abdomen. In 1654 two English Physicians, Bathurst and Heurshaw took up Van Helmont's experiments concerning the principal constituents of the air, and found oxygen to be the 'Principle of Life'. This was followed shortly after by Hooke's experiments. Coincident with the advancement of Lung Physiology, the Anatomy of the Respiratory system was further explored. In 1664 Maurocordatus experimented on the course of Blood through the Lungs. Leen^uwenhoek (1632-1723) demonstrated microscopically the Blood Cells and their movements in the Capillaries. Fredrik Ruysch (1628-1731) exactly described the Bronchial Artery Tree, and made himself celebrated by his anatomical injections, which showed the complete permeability of the circulatory system. This great discovery was enough to overthrow the physiology of Galen, and to give a new understanding of Respiration. The part played by the Humours could never be the same.

Boyle had shown that the creation of a partial vacuum was sufficient to kill an animal. Robert Hooke (1635-1702) showed that animals died in air which had been deprived of oxygen. Hooke was Boyle's assistant and was a great experimenter. He showed that animals required renewal of air if in a confined space, and he greatly improved the Artificial Respiration Apparatus invented by Vesalius¹². That a continued supply of air is necessary to life, at all events in the higher animals, is shown clearly by Hooke in experiments made before the Royal Society at some of

their early meetings. He showed how a dog was kept alive, after removing Ribs and diaphragm by blowing air into the windpipe with bellows; the absence of convulsions being noted. He showed also that the actual mechanical movements of the Lungs had nothing to do with the recovery as had been supposed, since he caused a continuous current of air to be blown through and allowed to escape by means of holes pricked in the Lungs.^{13.} Hooke himself points out that it was not the subsiding or movelessness of the Lungs that was the immediate cause of death, or the stopping of the circulation of the Blood through the Lungs, but the want of a sufficient supply of fresh air. Lower¹⁴ (1669) noted, by experiment, that change in colour of the blood occurred in the Lungs, not in the heart.

In 1661, Malpighi^{15.} published his work on the Lungs in which he stated that they were composed of lobules intercommunicating as well as communicating with the trachea, and that they were surrounded by a vascular network. In 1667 Swammerdam emitted a theory of Respiration known by the name of the Cartesian Circle because it was first suggested by Descartes, whose mechanical view of Life must be looked upon as an outcome, in some part, of Harvey's researches. He attempted to show that air entered the Lungs because it became rarified in the mouth, and that the atmosphere became condensed within the chest when it expanded. In 1667 also, Thomas Willis demonstrated the presence of Contractile muscular fibres in the smallest ramifications of the Bronchial Tubes. While Borelli^{16.} gave the true mechanism of

respiration, Bellini (1643-1703) regarded the diaphragm as the principal organ of Respiration, believing that its function was to force Blood into the Capillary Vessels.

Hooke's experiments were followed by those of John Mayow (1643-1679) who compared Respiration with combustion, in which oxygen was the flame of Life; it alone became mixed with Blood, reached the heart and there represented the principle of fermentation. When it penetrated the organism in too great amount it gave rise to fever. Mayow described a "Spirituo nitro-aetherio", which was really oxygen (1669) and asserted that air had two kinds of "particles". In 1674 he determined that animals consumed the nitro-aerial spirit in confined spaces. Mayow thus discovered oxygen in a physiological sense. Had he given the gas a less unfortunate name, he might have been recognised as its discoverer. His recognition of oxygen, or "vital particles", is contained in his "Tractatus quinque medico-physici, quorum primus agit de sal nitro et spiritu nitro-aereo. Secundus de respiratione". 1668., when he writes: "Circa Respirationis ergo usum affirmare fas sit nonnihilo, quicquid sit, aereum ad vitam sustinendam necessarium, in sanguinis massam transire. Hinc aer è pulmonibus egestus, è quo particulae istae vitales exhauriuntur, non amplius ad respirationem idoneus est"¹⁷.

Mayow also described combustible substances - "Salino-sulphureous particles" and held that combustion went on in the muscles themselves, although was incorrect in stating that it went on in the blood also. This is a point of some importance

since it was held, even by Lavoisier that the combustions take place in the Lungs, so that Mayow was in advance of his successors. The importance of Mayow's discovery was lost sight of in the rapid development of the Phlogiston doctrine, and the re-discovery of oxygen by Priestly.

~~published~~ The Eighteenth Century advances in knowledge are due to the direct continuation of researches of the previous century, and the century is fertile in discoveries of the highest importance. Harvey's great doctrine was attacked by Méry and Littré, but, thanks to Winslow and Sénac, triumphed. In 1707 Stroem expressed the necessity of expiration as an obligatory act following inspiration. Méry (1645-1672) was the first to show that air becomes mixed with the blood in the Lungs, and following this Helvetius studied the structure of the Lungs and maintained that the Blood was thickened by the addition of air. Lieberkühn (1711-1746) experimentally proved that air did not enter into the Pleural Cavity, while Hamberger and Haller (1708-1777) discussed the part played by the intercostal muscles and the diaphragm in respiration, a question which also occupied the minds of Sénac, Brémont and others.

~~declared~~ Haller is remembered for his foundation of anatomical physiology,¹⁸ but despite his knowledge of Hales' work on gases, makes little contribution to the physiology of the Lungs in his volume on Respiration. He submits that air does not enter the Blood, but in the Lungs loses its elastic nature and becomes soluble in water and vapour. Pulmonary exhalation, he claims,

consists chiefly of water impregnated with a volatile fatty exhalation with saline matter. After a period of controversy, knowledge of Lung function had waned temporarily following Mayow's discoveries, and Vitalism was offered as a solution where the scientific method was lacking. In 1774 Barthez published his "Les Nouveaux Eléments de la Science de l'homme" and in 1798 his theory in "Nouvelle Mécanique des mouvements de l'homme et des animaux", with which Vitalism came out in great vigour. If this remarkable physician had had the courage of his opinions, Vitalism would have triumphed during many years. His theory of the principle of Life composed of a Soul and a Vital Principle could not stand the test of the critics of his day and was doomed to failure.

1780 ~~Spain~~ New advances in chemistry of Respiration overturned the doctrine of Phlogiston, which was the joint honour of Stahl (1660-1734) and Becher, though the former contributed more to its establishment. Drs. Black, Kirwan and Priestley, illustrious advocates of the phlogistic doctrine, after an exertion, for a succession of years, of all their powers to defend the system, gave it up; and with a candour that adds lustre to genius declared to Lavoisier their conversion to the antiphlogistic system. Priestly (1733-1804), described "Dephlogisticated Air" and showed that air that had been spoilt by animal respiration was restored by green plants (1771). In 1790 he calculated the quantity of oxygen which passed into the Blood. The product of combustion was not known to Mayow, but was shown by Black (1755)

to be different from common air, and this he termed fixed air, though its true nature as carbon dioxide was found by Lavoisier.

The doctrine of Phlogiston was finally overthrown by Lavoisier (1743-1794) who in 1777 gave to the world his theory of respiration by combustion, a theory already prepared for by the discovery of oxygen, by the work of Mayow and Priestley. After he had advanced the science of chemistry by various brilliant and useful discoveries, he erected a durable monument of his fame on the ruins of the old doctrine of Phlogiston. The discovery of 'Vital Air' was the "salsa sine qua non" of the antiphlogistic school. Lagrange, 1791, put forward the modern view of the gaseous exchange in respiration, but stated that oxidation occurred in the blood itself, not in the tissues. In 1780 Spallanzani published his researches in which he states that tissues, like the Body as a whole, respire. In 1789 Crawford, in his work on animal heat completed the work of Lavoisier. In 1791, Gall admitted the existence of a vital force quite independent of the Soul. The recognition of the true nature of the gases exchanged in Respiration advanced the knowledge of Lung function considerably during the 18th Century.

There has existed from time to time an idea that gases exhaled from the Lungs contained toxic products other than simple combustion products. For example, an outline of a course of Lectures on the Laws of Animal Life, given in Manchester in 1820,¹⁹ gives as one of the Uses of Respiration "Its operation in removing a deleterious property from the Blood". Dr. Brown-Sequard (1817-

1894) collected moisture from expired air, and injected it into mice, causing Toxic Symptoms, and claimed to have demonstrated that expired air had a toxin coming from the Lungs, which was not carbon dioxide. Later, Dr. Glover Lyon believed in "Spirotoxins". In 1911, Weichardt, of Erlangen, thought he detected albuminous material from Respiration, a fatigue poison which he called "Kenotoxin". Indeed, a solution of antikenotoxin was put on the market before the War. Haldane discredits these theories and states that no example of a volatile albumen or protein is known.

In 1823, Edwards published his "Influence of physical agents on Life" and the older view that oxidation occurred in the Lungs was upheld, and it was not until Magnus' work in 1837 that the modern view was established. Magnus found that Blood passing to the Lungs contained more CO_2 and less Oxygen than that passing away from the Lungs. The effects of this discovery were to show that combustion does not occur in the Lungs, as Lavoisier had suggested, but that the blood acts simply as a carrier of the oxygen from the Lungs to the tissues, and of CO_2 from the tissues to the Lungs. We thus learnt to distinguish between external and internal respiratory processes. One of the most outstanding of Medical advances in the 19th Century was the use of Lung function as a means of administering general anaesthetics. Of the earlier uses may be mentioned that of Ether by Warren²⁰ and Gas by Morton in 1846, and of Chloroform by Bell and Simpson in 1847.

of respiration. Since Magnus introduced his modern conception of Lung function in the general Respiratory Process, intense experimentation, beginning in the middle of the 19th century and being carried on till the present day, followed. It is here proposed merely to outline the development of knowledge of Lung function. Inflation and deflation of the Lungs, with the Vagi intact, and then sectioned, led Hering and Brewer²¹ (1867) to conclude that there are two types of afferent nerves in the Lung alveoli, one stimulated by inflation and the other by deflation, forming a mechanism of self-regulation of Respiration by the Lungs. With animal experiment, using diaphragm-slip tracings, Head²² (1889) demonstrated relaxation and contraction of the diaphragm in Positive and Negative Lung Ventilation, and urged the prominent part played in the regulation of Respiration by the expiratory impulses. Lumsden recognised two types of afferent fibres in the Vagus, which affect Lung movements.

Lauder Brunton had already investigated the Lungs from the Pharmacological standpoint in 1874 when he noted that muscarin caused contraction of the Pulmonary Vessels, and produced dyspnoea.²³ In 1894 he described a "simple instrument for maintaining artificial Respiration in man for a long time with oxygen or atmospheric air".²⁴ In 1892 he applied artificial respiration with oxygen in Pneumonia,²⁵ and in 1912 for Angina Pectoris.²⁶ Various workers put forward methods of artificial Respiration, the most effective being that devised by Schafer. In 1904 Hamburger dealt with the Rib movements, with the mechanics

of respiration, the intrathoracic pressure and Pulmonary Ventilation. The Histology and the action of the Layers of Bronchial Musculative were determined at this time. The recognition of the influence of the Carotid Sinus, and particularly of a Respiratory Nerve centre, over Pulmonary function engaged the attention of many workers. Legallois and Flourens described a Respiratory centre, Lumsden described three, Brown-Séguard, Langendorff, and Wertheimer described several centres, some of which were later disproved. Schafer described the inherent rhythmicity of the Centre, while Rosenthal proved that its automaticity was not fundamentally reflex, but that it responded to all stimuli, continuous or rhythmic, by means of rhythmic discharges.

In 1909 Bohr²⁷ held that the Pulmonary epithelium actively secretes oxygen, and Haldane maintained that, under certain conditions, oxygen may be secreted. Haldane claimed that such a secretion could be demonstrated at high altitudes. A reinvestigation by Barcroft failed to lend confirmation to Haldane's conclusions. In 1910 appeared Krogh's remarkable work on capillary changes in tissue activity and respiration.²⁸ Krogh pointed out that the structure of the Pulmonary epithelium lends no support to the view that it acts as a secreting membrane, and his experiments show conclusively that the difference between the tensions in the alveoli, and in the Blood respectively, is always such as to allow of the passage by diffusion of oxygen inwards and CO₂ outwards from the Blood. In 1913 and 1914

appeared work by Christiansen, Douglas, and J.S.Haldane,²⁹ who found that reduced Blood has a greater ^{capacity} CO₂/than oxygenated Blood, that oxygen tends to displace carbon dioxide from the Blood, just as carbon dioxide is known to displace oxygen. Haldane and Lorrain Smith showed that increased pressures set up severe Lung inflammation. The effects of changes of atmosphere on Lung function have been recorded by various observers, notably by Zuntz on Mount Rosa, by Barcroft, Meakins and others³⁰ in the Peruvian Andes, and by Douglas, J.S.Haldane, and Henderson,³¹ 1913, on Pike's Peak, Colorado. The effects are chiefly of inability to co-ordinate muscular movements, hyperpnoea, Cheyne-Stokes Breathing, and Cyanosis. Further observations were made during Mount Everest expeditions more recently.

Advances in Applied Physiology have been mainly in the form of quantitative estimations, such as Douglas' Method of analysis of expired air, the use of the Douglas Bag in the calculation of Basal Metabolism, Haldane's estimation of the Alveolar content of Carbon Dioxide, Buckmaster and Gardner's method of Blood gas estimation,³² 1917; Barcroft's determination of the oxygen-capacity of a sample of Blood, 1917, and Haldane's Ferricyanide method of determination of Blood oxygen. More recently attention again centered on the question of Vagal influence, when advances were made over the work of Hering, Brewer, and Scott by Shaw Dunn, 1919 and Schafer,³³ 1919, who showed that without Vagal influence animals may maintain a comparatively normal Respiratory Rhythm, and may live for weeks. The use of

CO₂ as a Respiratory stimulant was recognised.

A brief survey of our knowledge of Lung function, from the historical point of view, calls for little consideration of present day work. Suffice it to say that this age is one in which an attempt is made to put medical knowledge on a scientific basis. A wealth of modern literature testifies to the attempt to further the knowledge of Lung function. One who has witnessed animal experiments on Lung function carried out by such a worker as McDowall of London, and has heard the recent reports of Daly³⁴ and others in Edinburgh and elsewhere, on the investigations particularly of the Vascular System of the Lungs, realises that the present age is one of earnest search for knowledge. Much remains to be learnt of the working of the Lungs, of their highly complex structure and of their relationship to the activities of the blood-vascular and nervous systems. Progress is the result of frequent repetition and careful observation. There is still a need for animal and human experiment to further the knowledge of Lung Physiology, the history of which shows that knowledge does not accumulate steadily, and is gained at the expense of effort. The working of the Lungs is but one aspect of Respiration and Respiration but one aspect of Body function. As Bernard strikingly puts it, "We do not live in air".

A consideration of Lung Physiology gives no scope for discussion of the associated studies of the history of Lung diseases, particularly of Tuberculosis, or of the development of Pulmonary Surgery. Despite our present knowledge of the Lungs,

their diseases, together with general respiratory affections, still constitute one of the commonest causes of death. The results of future advances in knowledge should be utilised in the amelioration of the present state of affairs.

“There is a natural tendency to overvalue new information in relation to pre-existing knowledge. Hence it is desirable, if we would cultivate perspective and do justice to our predecessors, that we should from time to time look back into the past and attempt to visualise and appreciate the significance of advances which may be regarded as landmarks in the course of progress.”³⁵

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NOTES.

17. "With respect then to Respiration, it may be affirmed that an aerial something, whatever it may be, essential to Life,

passes into the mass of the Blood. And this air driven out of the Lungs, these vital particles having been drained from it, is no longer fit for breathing again."

4. "The onset of delirium, the whistling of the breath in the throat, and sounds intermittently resonant or sibilant in the affected area."

The 17th and 18th Century dates given are mainly those given by Cumston. Some difference exists in these dates by various authors. The first use of ether in operations, by Warren, is a matter of dispute. For example, Leeson describes "the first operation ever performed under ether" by Liston in 1846. - J.R. Leeson. "Lister as I knew him". p.112.