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THE CONTRIBUTIONS OF JOHN SCOTT HALDANE TO MEDICINE.

INTRODUCTION.

As a climber stands at the base of a high, strange cliff - much of which is masked from sight as it bulges skywards - he may well pause a moment slightly apprehensive of the task facing him. It is a brave man who ventures onwards -exploring various routes and seeking to discover a way upwards. However, bravery alone is not enough and may indeed be suicidally dangerous - the mountaineer who wins the crest after a thorough exploration of the challenge presented to him is not only brave but also superbly fit and trained and disciplined in the craft of his profession.

So it is with the subject of this essay - John Scott Haldane, whose impatient quest for knowledge could scarcely await the throwing off of his undergraduate shackles. Resolutely he accepted the challenge presented by the whole field of human knowledge, tackling the most formidable problems and devoting his life and talents to their exploration and elucidation till at length he attained the crest of his hill - still striving assiduously despite his years to add to the impressive amount of work which he had covered in the fields of philosophy, physiology, biochemistry, mining theory and hygiene, compressed air diseases and public health.

The range and depth of his work, indeed, form another cliff before which the would-be reviewer pauses more than a little apprehensive of the difficulties ahead. Even confining our attention purely to his medical work we are dealing with a gully which has many crevices and offshoots and which would require for its adequate assessment far greater bounds than can be provided by such an essay as this. This preliminary survey, for it can be no more, is written in the hope that it may aid those reviewers yet to come in their task of placing a great man in his true perspective.

OUTLINE of HIS LIFE

John Scott Haldane was born on the second of May 1860 in Edinburgh - born into a family distinguished by many famous sons (1) amongst whom he was to take his place as one of the most capable. Educated at the Edinburgh Academy and the Universities of Edinburgh and Jena, he graduated M.A. before proceeding to study medicine in which he graduated MB.ChB. at Edinburgh in 1884. During a short spell in Dundee with Professor Carnelly his interest in respiration and gases became manifest and this developed still further in Oxford - whither he moved in 1887 to become Demonstrator in Physiological Chemistry under his uncle Sir John Burdon Sanderson.

For the rest of his life his home was in Oxford though he travelled widely - ranging abroad physically over almost as wide a field as his active mind covered in the realms of thought. Essentially a deep and careful thinker, Haldane saw from his earliest days the linking of philosophy and science and the inseperability of theory and practice. Thus he saw nothing incongruous in a research respiratory physiologist being at the same time a philosopher and an active figure in the fields of mining hygiene, public health and, in his later days, renal function and colour vision. To all of these he brought a sharp yet profound mind which could cleave through the superficial cloud of irrelevancies which surround any subject and find the basic truths lying at its heart. Moreover, he possessed in high degree that essential quality of the teacher - the power to make this central idea appear simple to others.

Add to all this "an outstanding personality" with a "kindness and regard for others (which) made an ineffaceable impression on those working with him" (2) and we have an outline picture (3) of John S Haldane - an outline which this short study will, alas, be able to fill in only sketchily.

FULLER DEVELOPMENT

In the thesis which follows, attention will be confined almost entirely to the medical aspects of J.S. Haldane's work. However, for those who wish to investigate further his work in other spheres, the bibliography of his books (Appendix A) and papers(Appendix B) is not confined to those on medical subjects. The arrangement is chronological and references in the text are given in the form (Appendix; Year & letter) thus (A 1917 C)

UNDERGRADUATE DAYS

Even as an undergraduate, Haldane's basic concern with the relationship between the different branches of knowledge became apparent (B.1883 A; 1884 A) as did his interest in medical and other education. His letter "To Edinburgh Professors" (B.1890 A) might well be read with profit by all those who are currently engaged in planning the medical curriculum and also by all those who would find out the basic purposes of a University education. Already visible too is his strong independence of thought and this disinclination to yield to the opposing views of others (for the very excellent reason that his own ideas were usually proved to be correct) was to be an outstanding characteristic of Haldane all his days - though later his tolerance of these different views would probably have made his attacks upon them less vitriolic than the attacks which he then delivered through the example of Professor Landois' Textbook of Physiology. Despite their gentleness and tolerance, however, these later aggressive excursions were none the less effective than the earlier.

DUNDEE DAYS

Haldanes' many interests tended to spring one from another. Thus we are told by Douglas (2) that his interest in respiration was triggered off by breathing foul air - just as respiratory work led him to the Cornish tin mine where the working conditions aroused his inquiries

into the effect of a hot environment upon the body and also to the collieries to investigate death by asphyxiation following mine explosions - an assignment which not only started up his lifelong connection with the mining industry but also introduced him to the carbon monoxide which was to play such an important part in his later physiological researches.

Although he spent only three years as Demonstrator of Physiology in Dundee, this time must rank as one of the great formative influences in Haldane's career. He would have succeeded in any field and the study of respiration must owe much to the foul air of these tenement blocks in Dundee which directed his talents to its study.

The main result of his work in this period was the proof that 'sewer gas' is not the causative factor in the spread of the common fevers (B.1887 A) and the studies concerned led to several smaller papers on the same subject. (B. 1887 B; 1887 C; 1887 D;) He also carried out a brief biochemical investigation on the fevered patients(1888 A)

RESPIRATORY PHYSIOLOGIST

As Demonstrator in Physiological Chemistry under his uncle Sir J.B.Sanderson and later as Reader in Physiology, Haldane continued to work on the problem of the impurities present in air and their physiological action (B. 1890 A; 1892 B;C;) With Lorrain Smith, later to come to the chair of Pathology here in Edinburgh, he was investigating "the actions of carbonic acid in the regulation of breathing" (B. 1890 B) and also the properties of the red blood cells (B. 1894 A) and haemoglobin (B. 1898 B; 1899 B) - in particular the colorimetric method of measuring it which is still associated with his name (B. 1900 B)

Many papers on carbonic acid appeared before the problem was solved. (B. 1889 A; 1890 C; 1895 A;B;C; 1897 B; 1899 A;) Then, in what must rank as his greatest single theoretical achievement, he succeeded in proving that the stimulus for respiration is not anoxia as had previously been thought but was, in fact, carbon dioxide to small changes in whose concentration the respiratory centre was exquisitely sensitive.(B. 1904 C) This discovery allowed the first rational explanation of the bodily changes with exercise and formed the basis of many resuscitation techniques and the development of (B.1924 D) (B.1924 I) modern anaesthesia. In the course of this work he had (B.1925 I) designed much apparatus and in addition to his haemoglobin device mentioned above even the most elementary textbook makes mention of his gas analysis apparatus (B. 1898 B)

This discovery acted as another landmark in Haldane's philosophical development and, convincing him of the integration of the body as a whole, spurred him to further pure research on such assorted subjects as dyspnoea (B.1908 A); apnoea (B.1908 C); the regulation of breathing (B.1908 H;I; 1913 B; 1914 A; 1915 C; 1918 D;) the volume of the air passages and dead space (B.1912 C; 1915 A) and the method of absorption of oxygen by the lungs - especially in cases of low atmospheric pressure. The experiments on this work took him as far afield as Pike's Peak in Colorado (B.1912 D; 1913 A;) and forced him to the one conclusion of importance which later work (9) has upset - namely that the lungs actively secrete oxygen in order to maintain the arterial oxygen tension (B. 1899 C;D; 1908 F;G; 1909 B;1910 A;B;E; 1911 B; 1912 B; 1919A;C;) This was opposed by Barcroft who maintained (9) that the process was purely one of diffusion and discussion ranged for some time(B.1924 A)

Haldane's interest in oxygen had also a therapeutic side and numerous practical papers appeared. (B. 1919 I; 1920 A; 1921 D; 1932 A; 1933 A;) The practical aspects of his work, however, will be considered below.

PRACTICAL APPLICATIONS

MINING

As a respiratory physiologist, Haldane had been concerned in the investigation into the causes of death in colliery explosions (B. 1895 F; 1896 B). This started off a life-long association with the mining industry during which he did much research into mining problems and also into the diseases of miners. In 1906 he was appointed to the Royal Commission on Coalmines and Metalliferous Mines and in 1912 he became Director of the Doncaster Coal Owners' Research Laboratory . When this was transferred in 1921 to Birmingham, Haldane was appointed Hon. Professor of Mining in the University there. In the years from 1924-8 he was President of the Institute of Mining Engineers (B.1924 B) and in 1928 was made a Companion of Honour for his services to industrial hygiene (B.1928 C). Of all his many awards, honours and degrees we are told that he cherished this highest.

Of his mining papers we can say nothing here. His animal and self experimentation on black damp and its effects (B.1895 D) led to the introduction of mice and canaries as a sensitive index of danger and his concern with miners' safety never failed. (B.1910 C:1912 F; 1914 C;D; 1933 C). His interest in the miners' diseases centred on miners nystagmus - on the causes and prevention of which he wrote voluminously (B.1923 C; 1925 A;E; 1926 D; 1927 B;D;E;) and the correlation of silicosis and tuberculosis. (1916 A: 1918 E; 1929 C; 1931 A; 1934 A;B; 1935 A; 1938 A) However, he had also become interested in an outbreak of ankylostomiasis in Cornwall which he followed up carefully. (1902 B; 1903 A; 1909 C)

Those who are interested in Haldane's deep concern for the welfare of the miner and who seek more information than is given in this outline are referred to the bibliography and also to the Transactions of the Institute of Mining Engineers in which he features regularly and respectedly as befits a good friend.

PUBLIC HEALTH

The interest which Haldane took in the diseases of miners was not by any means his only connection with public health. President in 1904 of the Sect. of State Medicine BMA., he did much work over the years on gas poisoning and its treatment (B. 1896 A; 1899 B; 1900 A; 1903 B; 1904 A;B; 1908 D; 1912 A; 1917 A; 1918 B; 1919 H;I; 1920 A; 1924 D; 1925 B;C; 1926 A; 1930 A;) as well as the influence of hot temperatures on the body temperature and the limiting factor of the reading of the wet bulb thermometer. (B.1905 A;B; 1908 K;)

As well as being a member of the board of Gas Referees for many years, Haldane served on commissions concerned with the ventilation of the Metropolitan Railway, factories and workshops (4)

PUBLIC BODIES - THE FORCES

Public bodies as well as public health occupied much of his time as he tended to do a great deal of the research work for the committees on which he served. The first which must claim our attention is that concerned with the Senior Service - the Admiralty Committee on deep diving (B.1907 A) The cause of bends had been elucidated previously by Paul Bert (8) but it is to Haldane and his co-workers that the credit must be given for the practical achievment of showing the safety of stage decompression (rather than the slow decompression advocated by Bert and shown by Haldane's group actually to be dangerous) The group worked out the necessary tables and Haldane later returned to this work - first to extend it to all compressed air workers (B. 1908 E;) and later, in 1935, when he extended the results to include the greater depths then being used. He also advised the Admiralty on "battleship ventilation and air purification in submarines " (4) and one is tempted to wonder whether the back alleys of Dundee were the only place that aroused Haldanes campaign for fresh air.

Turning our attention next to the army, we find Haldane once more the humanist, being instrumental in improving the rations in the concentration camps during the South African War and also for our own troops when on active service (Commission on Physiol. Needs of the soldier in food, clothing and training)

At the start of the Great War, Haldane was responsible for identifying the type of poison gas which was being used, studying its effects and working out treatment of the acute and chronic case. Though not a member of the Commission concerned he was instrumental in designing and speeding production of a portable oxygen administrator for use in field conditions.(2)

When the Royal Flying Corps came into being, much of Haldane's work on low barometric pressures was, of course, of great application (p5 above) and in his later years Haldane "devoted considerable time to safety for aviators" (4)

TRAVELLER ---- - - - - - in lands

Although Haldane spent the greater part of his life with his home in Oxford and though he rarely took a holiday - yet in his writings we can find many references to his extensive travels. Look at the laboratory of origin of his paper - sometimes you will find Oxford, but perhaps Belfast (B.1899 D) or, if you would go further afield, even Copenhagen (B.1894 A). Search diligently and you may even find that trait least characteristic of the insular - papers published in foreign periodicals (B.1909 D; 1911 B; 1915 A)

But without such care - his experimental laboratory took many strange forms :- collieries (B.1895 D) ships (B.1907 A) even the top of Ben Nevis (B.1904 B) When Scottish hills became too low for the work which he was doing, there came that joint expedition with Prof. Yandell Henderson of Yale to Pike's Peak - one more great milestone in Haldane's experience of the body

as a unity - an integrated whole. This is said by Douglas to have been responsible for his turning to the kidneys and their action -varying with the needs of the body (1915 B; 1921 C) and this research was to tie up with his later interest in salt metabolism from the viewpoint of miners cramps in hot atmospheres. (B.1928 B;D; 1929 B)

Further travels are hinted at (1926 B) and how refreshing it is at the end of an article to find acknowledgements -not to the essential but slightly prosaic statistician or technician but to "the dragoman of Messrs. Cooks Nile Service"/ Would scientific research had retained some of the leisurely pace of that peaceful era!

Perhaps this hint of the Middle East is the most fitting on which to close this section as in was shortly after his return from a visit to the Persian oil refineries where he was studying heat stroke that John S Haldane died of pneumonia at midnight of 14/15 th March 1936 - in harness till the end as he would have wished.

TRAVELLER - - - - - - in ideas

It is impossible to close this sketch without reference once more to Haldane's philosophy. Like so many before him, he used examples drawn from the world and from biology in particular to illustrate his theses. Indeed, his study of colour vision was made entirely for this purpose as it illustrated so well his Berkleyan concepts of relativity. From the start he argued the oneness of theory and practice and in his own life provided unarguable proof of the validity of his proposition

However, tempting though it is to stray into the fields of Haldane's philosophy, this can be no more than an acknowledgement of the great part which his clarity of thought and lucidity of expression played in his medical work -both theoretical and applied. His philosophical works lie waiting for any who would follow his precept and bridge the artificial gap which the last few decades have introduced between the sciences and humanities. Those of us in the field of medicine may well consider that we have allegiance in both camps - Haldane demonstrated that it is possible to live in both worlds.....only to find that they are really one.

CONCLUSION

And so we have come full circle and are once more faced with a challenge as we were at the start of this enquiry - a challenge which can only emphasise our admiration for the man who accepted and triumphed over the challenge presented by the problems of his day.

In Haldane's own life, too, we can find the turning circle -symbolic, perhaps, of that unity which he found in life - for his last published paper (in the BMJ B.1933 B) was like his first (1883 A) an expanded form of a Dissertation to the Royal Medical Society here in his birthplace.

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1924 B "Biology and Religion"
Nature 114 468.

1924 C "Physiological problems in mining"
Trans.Inst. Mining Eng. 68 34

1924 D "Use of carbon dioxide as a remedy in gas poisoning"
ibid 271.

1924 E "The values for which the Institute stands"
(Presidential Address)
ibid 356.

1924 F "Spontaneous combustion of coal"
ibid 473.

1924 G "Maximum efficiency of heat engines and the future of coal and steam as motive agents"
ibid 69 383.

1925 A "Aetiology of miners' nystagmus"
(Section Ophth. Roy. Soc. Med.)
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1925 B "The presence post-mortem of nitric-oxide--haemoglobin - its clinical and medico-legal significance"
with Banham and Savage
ibid 2 187.

1925 C "Blood Transfusion in carbon monoxide poisoning"
(corr)
ibid 1146.

1925 D "Some bearings of the physiology of respiration on administration of anaesthesia"
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1925 E "Discussion on miners' nystagmus"
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Brit.J.Ophth. 9 545.

1925 F "Thermal efficiency of a Carnot engine"
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1926 A "Treatment of carbon monoxide poisoning" (corr)
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1926 B "Rate of work done with an Egyptian Shadouf"
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Nature Aug 28th

1926 C "Acclimatization to high altitudes"
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1927 A "The sciences and philosophy"
(Gifford lectures cf Appendix A - 1928 A)
Brit.Med.J. 1 257, 351, 398, 442.

1927 B "Causes of miners' nystagmus"
ibid 809.

1927 C "Biology and medicine"
ibid 909.

1927 D "Miners' nystagmus " (corr)
ibid 2 37, 192.

1927 E "Demonstrations with a lamproom photometer"
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1928C "C.H. conferred" ?
ibid 988.

1928 D "Salts lost by sweating owing to high air temperatures" (16th report of committee of atmospheric conditions in hot and deep mines)

1929 A "The influenza epidemic of 1918 - colour of blood in fatal cases"
Brit.Med J. 1 1070.

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1929 C "Avoidance of silicosis with dry methods of working"
ibid 543. (in report of BA meeting)

1929 D "Claude Bernard's concept of the internal environment"
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1931 A "Silicosis and coal mining" (corr)
ibid 1 154

1931 B "Atmospheric pollution and fogs"
ibid 366.

1931 C "What is life?" (corr)
ibid 2 776, 869.

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ibid 1 144.

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ibid 172.

1933 A "Oxygen therapy"
Brit.Med.J. 2 23.

1933 B "Vision of Brightness and colour"
(expanded address to Royal Medical Society)
ibid 1153, 751.

1933 C "Treatment of burns"
ibid 786.

1933 D "Weber's Law and colour contrast"
J.Physiol. 79 121.

1934 A in "Causes of Silicosis"
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ibid 452.

1934 C in"Malnutrition"
ibid 1170.

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ibid 1 322.

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