Archibald Byron Macallum, 1858 - 1934

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ARCHIBALD BYRON MACALLUM 1858–1934

Macallum's monument is the Medical School of Toronto. Fifty years ago, when he joined the staff of the University as lecturer in biology, the medical school was in much the same condition as English provincial schools a generation earlier, little more than a private venture of medical practitioners laudably endeavouring to hand on to others what they happened to know. Thirty years later it ranked among the first two or three on the American continent and could teach the world.

He was born on a farm in Western Ontario. In his childhood at home he spoke and heard only Gaelic; English he learnt at school. His father had come out from the highlands of Scotland to Canada in 1830, where he brought up a family of twelve children, three of his six sons becoming doctors of medicine.

He went from the rural school to the high school at the neighbouring small town of London and obtained a first class teaching certificate before he was 17. He taught in a country school near his home for two or three years, saving his money to go to the University. He took his degree at Toronto when he was 22, and having come under the influence there of an inspiring teacher, Ramsay Wright, Professor of Biology, he obtained the medal in natural science.

With his B.A. degree he obtained a post in the high school at the town of Cornwall in Eastern Ontario on the St. Lawrence, where he lived for three or four years. Here he met his future wife and also established a lifelong friendship with a young lawyer who was later to become for many years Premier of Ontario, Sir James Whitney, a friendship fraught with great significance for the cause of higher education in Canada.

While holding this post he managed in his spare time to keep up his scientific work with Ramsay Wright and in 1883 he returned to Toronto as lecturer in biology. During the next seven years, while fulfilling his duties in this capacity, he worked for his medical degree, not only at Toronto but also in the recently founded Johns Hopkins University at Baltimore, where he came under the strong influence of Newell Martin, who had come from England to be the first professor of physiology there. From that university he obtained the Ph.D. degree in 1888, when he was 30, and two years later he took the M.B. degree of Toronto. In the same year an independent chair of physiology was first instituted at Toronto and Macallum was appointed to it.
With other pupils of Ramsay Wright's, first James McMurrich in the chair of anatomy and a little later J. J. Mackenzie as professor of pathology, both of them, like Macallum, biologists before, as an afterthought they had studied medicine, a nucleus was formed for the band of Scots whose fighting leader was Macallum. On the clinical side they could count on the enlightened support of Alexander McPhedran, professor of medicine, and of Irving Cameron, professor of surgery, and in a few years this company completely transformed the medical school, gave it new ideals and built it on a sound foundation of biological science. Local opposition, also largely Scottish, was hot, and the transformation cost much in sweat if not in blood.

When the fighting was mostly over, in 1908, T. G. Brodie was invited from England to take the chair of physiology, while a new chair of biochemistry was created for Macallum. A year later, similarly at Macallum's suggestion, a new chair in pathological chemistry was instituted to broaden the work in pathology in the direction in which his interests specially lay.

Eight years later, in 1917, Macallum left Toronto to take up at Ottawa the duty of organizing the new National Research Council, an appointment for which his scientific standing and the success with which he had upheld scientific ideals in Toronto marked him out. After three years of valuable and arduous work in creating what was almost a new Government Department, he was glad at the age of 62 to return to academic life at Montreal as professor of biochemistry in the McGill University. There he worked till six years ago, when at the age of 70 he retired to the neighbourhood of his birthplace, the town of London, where now there was a university with a flourishing medical school in which his brother, Hugh Macallum, had rendered valuable service as Professor of Medicine and one of his sons was, and is, Professor of Biochemistry and Dean. There he died on April 5, 1934.

The influence which Macallum exerted in Toronto was due to three things. He was a forceful personality, he had vision and he worked unceasingly. When he was appointed Professor of Physiology he had no department, no staff. For years he had to do the whole teaching of students of medicine and science in all branches of his subject himself single handed. He built up as time went on an effective department, one of the best in America. But with all that this involved he was untiring in his pursuit of his own studies, much of his work during term time having to be done at night.

He will be remembered for the work he did in two subjects especially. The first was the microchemical investigation of the distribution of
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inorganic salts or their ions in cells. Having proved in his first important publication (1891) that nuclear chromatin contained iron, he went on to work out methods for detecting in microscopical preparations of tissues or cells the location of potassium, of chloride, and of phosphorus. The most remarkable results he obtained with potassium. These he published after many years' work in 1905, the year before his election to the Fellowship of the Royal Society, which he was the first graduate of Toronto to receive. His paper in the *Journal of Physiology* (vol. 32) is full of amazing observations that must furnish food for thought to cytologists for years still to come. To take instances; he could get no evidence that the nucleus of any animal or vegetable cell ever contained a trace of potassium, or chloride, or phosphate, although in the cytoplasm at its surface potassium might be aggregated in an astonishing way; the localization of potassium in certain positions in gland cells, in the myelin sheath of nerves, and in the doubly refracting band of striated muscle which the reproductions of his fine preparations show is wonderful, but no less is the fact that nerve cells and their axons and dendrites never could be shown to contain any while a remarkable preparation of a ganglion cell from the retina has ramifying on its surface a structure with what looks like *boutons terminaux* rich apparently in potassium.

Such observations, it is no wonder, fascinated him and he spent years trying to fit them an explanation borrowed from the physical properties of surfaces. If he was not always convincingly successful it was only because it must still be years before the chemical architecture of the cell, of which what he describes is one of the revelations, can be clearly understood.

The other field in which he worked for long was the quantitative determination of the positive inorganic ions in the blood and body fluids of vertebrate and invertebrate animals. He established the fact that the proportions in which Na, K, Ca, Mg occur in these fluids is extraordinarily like those in which they occur in sea water. In marine invertebrates with a vascular system communicating with the exterior the fluid that bathes the cells is sea water; in those with a closed system the fluid bathing the cells still contains these elements not only in the same proportions but in the same concentration as the sea, and varies with that concentration where the sea is diluted with fresh water. This was doubtless the case, too, with the closely related forms their ancestors took when vertebrates were being evolved from them, only at that time the concentration of salts in the sea, which has been growing throughout its history, was much less. In vertebrates, however, the power of preserving the osmotic pressure of the fluid bathing their cells, the *milieu*
interne, at a uniform constant level is one of the most important distinguishing marks, and must have been acquired from the first; that is to say, at that time, in the Silurian period or earlier, when they were being evolved and when the concentration of the salts in the sea was, he argues, that which is still found in their blood, less than a third of what it is in the sea to-day.

Indications of transitional stages through which animals had to pass in acquiring this power he met with even in the lobster, where the low relative proportion of magnesium is the only difference between the inorganic salts of its blood and those of the sea, the only difference he found in any invertebrate. In the sea magnesium is present in as much as 12% of the amount of sodium, in the lobster it is less than 2%, in the frog and mammals less than 1%. Again, in Selachian fishes the total osmotic pressure of the blood is no lower than that of sea water, but then only half of it is due to inorganic salts, the difference being made up by urea, of which 2% or more is found, showing that the adjustment of salt concentration is an older function of the kidney than the elimination of end products of nitrogen metabolism. Already in teleostean fishes the typical vertebrate condition is practically perfected.

Among higher vertebrates such minor differences in the ratios as he found he was prepared to set down to changes in those ratios in the sea which he gave reasons for thinking must have occurred. In addition to the difference in the magnesium just referred to, the potassium is consistently present in an amount forming 6% of the sodium. Whereas in the sea it is less than 4%. Both these differences and a smaller one in the proportion of calcium are merely corroborative in his view of the main thesis, for the potassium in the sea has been steadily diminishing and the magnesium increasing relative to the sodium.

Moreover, from the analyses of undifferentiated vertebrate cells typified by the unfertilized ova of the herring, in which he found twice as much potassium as sodium, he argues that this feature reproduces the condition of the sea at a far earlier time still in its history. He was tempted even to infer from the concentration of sodium in such cells, one-twelfth of that in the sea to-day, that the unicellular ancestor of vertebrates was in existence when the age of the ocean was only one-twelfth of its present age. Translating his argument, therefore, into figures such as are now commonly hypothesized, which give for the age of the ocean something like $12 \times 10^8$ years, all animal life was in the unicellular stage $11 \times 10^8$ years ago, but had already acquired its nucleus and chromosomes, free from potassium, chlorides and phosphates, but containing iron, and vertebrates with four times as much
sodium in their plasma as was in their unicellular ancestors appeared on the earth $8 \times 10^8$ years ago.

Such inferences as these he advanced, of course, with all reserve. But it is right to refer to them partly because they were drawn from laboriously established analytical data, and partly because they seem to be typical of his philosophical mentality, visions that were for years hovering before his eyes and beckoning him on.

He had a bent for metaphysical discussion. His friends looked forward to the annual gatherings of the biological societies in one or other of the universities of North America, when in the precious intervals of business he was ever ready to discuss more things in heaven and earth than were dreamt of in their philosophy. Whatever he spoke of he would illustrate with the rich store gathered by a retentive memory from wide reading. In his youth he had learnt volumes, poetry and prose alike, by heart. There was a time, for instance, long ago when Byron was his hero, and thereby hangs a tale. He was always known to his friends as A.B. But these initials he had not come by in the usual way. It is told that when in his teens he came from a remote country farm to enter at the University he was asked his name and initials, having replied A. Macallum, he was taken aback when he was asked if that was all. As another initial seemed to be required he replied A.B., Archibald Byron.

He had a tall dignified figure and some thought a dour forbidding look, but if that was so it only heightened the effect of the glitter that came into his eyes when he had, as he so often had, a kind thing to say, or a story to tell and no doubt as his opponents knew when he was stirred to fight.

He did a great work for Canada in higher education and especially in scientific medicine.

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