

reading, with a special bent in the direction of philosophical studies which he found time to pursue in the intervals of his engrossing professional work. Though he spoke English imperfectly, he could read it with ease, and thus kept himself abreast of the advance of scientific and philosophic thought in this country. The writer well remembers that when, in 1877, he was working at Würzburg, Sachs was engaged with the writings of Herbert Spencer and of Lecky. Possessed, as he was, of a fund of humour, of a singularly acute intellect, and of a great store of information, Sachs was a brilliant talker. Altogether he was a remarkable and conspicuous figure, not among the botanists only, but among the men of science of his time; and in losing him the Royal Society has to deplore the loss of not the least distinguished of her Foreign Members, and of a worthy successor to Grew, Malpighi, Hales, and Knight.

S. H. V.

SAMUEL HAUGHTON, who died on the 31st October, 1897, sprang from an old Quaker family, and although both of his parents had withdrawn from the Community of Friends, he spent his boyhood amidst Quaker surroundings. The early impressions which he then received remained permanent through life, and he retained deep-rooted within him many of the best of the Quaker principles.

He was born in Carlow on the 21st December, 1821, and was early sent to a large school which was kept in that town by the Rector of the parish. It was during his school life that his interest in natural science was awakened. He had the good fortune to come under the influence of Mr. Emerson, one of the masters of the school, a most gifted scholar, and a man endowed with a profound love of nature. With him as an associate young Haughton roamed over the surrounding country in search of specimens. The banks of the beautiful river which flows through his native town, the bog-land in the immediate vicinity, and the slopes of the neighbouring hills, were systematically explored, and botany and geology became his favourite recreations.

At the age of seventeen Haughton entered Trinity College, Dublin. He possessed in a remarkable degree the qualities which lead to success in college life, quickness of apprehension, a clear head, and a tenacious and ready memory. Indeed the distinction which he attained as a student was such that immediately after taking his degree, an unexpected vacancy having occurred, his friends induced him to enter as a candidate for Fellowship. With little more than six months' preparation, he succeeded at his first trial (1844) in that most formidable examination, a feat quite unprecedented in the history of the college. Set free thus early from the prolonged drudgery which is the usual preliminary of a Fellowship contest, Haughton had the rare good fortune to be able, untrammelled by

the fear of impending examinations, to follow out those lines of study and research which his natural bent of mind made him specially qualified to undertake.

He lived in the same house in college as the eminent mathematician McCullagh, and conceived the warmest regard and admiration for him. Very possibly it was due to this association that Haughton's earlier work was in the domain of physical science; and at the age of twenty-six he obtained his first extra-collegiate distinction, viz., the award of the Cunningham Medal by the Royal Irish Academy for his memoir "On the Equilibrium and Motion of Solid and Fluid Bodies." Soon, however, he turned his attention to geology, and in 1851, on the removal of Professor Phillips to Oxford, he was elected University Professor in that subject. This chair he occupied for thirty years, and only resigned it on his appointment as one of the Senior Fellows of Trinity College in 1881.

Very early in his career, before he had entered college, Haughton had shown a strong inclination towards the profession of medicine. It was his boyish dream to prepare himself as a medical missionary, and to devote his life to missionary work in China. It was the old Quaker instinct working within him, an instinct which became the great ruling principle of his life, the desire to succour and help the weak in the great battle of life. It is fortunate for science and the cause of education that his early ambitions were not realised. Still, although his thoughts were for the time deflected into other channels, and his duties as a Fellow of the College and as Professor of Geology led him into a totally different field of work, his early yearnings were not completely eradicated. The natural course of events had drawn him away from medicine, but geology brought him back to it. He perceived that he could not properly treat of animal remains preserved in fossils without a knowledge of comparative anatomy, and the readiest means of obtaining this knowledge appeared to him to lie in the thorough study, in the first instance, of human anatomy. He was thus led to enter the Medical School, and consequently we find him, at the somewhat advanced age of thirty-eight, and already a Fellow of the Royal Society, already widely known as a mathematician and a geologist, undergoing all the drudgery attending a course of professional study. Well aware that there is no royal road to knowledge, he threw himself into the full routine of attendance on lectures and hospitals, and pursued his dissections and laboratory work as cheerfully as the youngest student in the school, and as assiduously as if he had to earn his bread by the practice of medicine. Although greatly burdened by other duties, he passed all the degree examinations at the prescribed periods, and finally graduated in medicine in 1862.

Thus introduced into the inner life of the School of Physic,

Dr. Haughton could not help seeing that it stood sadly in need of reform. Although the medical degrees of the University were at that time eagerly sought by young medical aspirants, the school of Trinity College was the last place where they cared to study. Immediately after his graduation, Dr. Haughton threw his whole energies into the improvement of the school, and to attain this end he was not slow to use the influence which he had deservedly acquired with the senior members of Trinity College. He was appointed Medical Registrar, and at once proceeded to work. To render the reform effectual it was necessary to grapple with many ancient abuses—a task from which he did not shrink. He was a man of unbounded courage and great pugnacity—to join in a fight was never unwelcome. But these instincts were kept in check by great kindness of heart, and none of his former antagonists who may have survived him has cause to remember with pain any expression he ever used. The years which followed proved a somewhat stormy period in Dr. Haughton's life, and he had to adopt in certain instances measures which might appear to be harsh, but which were rendered absolutely necessary by the exigencies of the case. One of his leading characteristics was his absolute unselfishness, and it may be well to mention in connection with these controversies that no one could point to a single act of his which was dictated by self-interest. But he was stern and almost unforgiving with those who, by idleness or otherwise, did damage to the good name of the college he so sincerely loved. When Dr. Haughton took in hand the reform of the School of Physic it was one of the most insignificant of the schools which then existed in Dublin; now it takes the foremost rank, and this change, brought about in little more than thirty years, is largely, if not entirely, due to the sagacious and enlightened manner in which he guided its policy.

It was during the earlier years of his connexion with the medical school that he commenced a series of observations on the mechanical principles of muscular action. The results of these investigations appeared from time to time in the 'Proceedings of the Royal Society,' and of the 'Royal Irish Academy,' and ultimately took final shape in his book on 'Animal Mechanics,' which was published in 1873. This is probably Dr. Haughton's greatest work. For ten years he laboured at it, and during that time it was his daily practice to spend two hours in the dissecting room in the study of the comparative anatomy of the muscular system of vertebrates. What may be regarded as being the key-note of the work is struck in the following short extract from the preface. He says:—"I have met with numerous instances in the muscular mechanism of vertebrate animals of the application of the principle of least action in Nature; by which I mean that the work to be done is effected by means of the

existing arrangement of the muscles, bones, and joints with a less expenditure of force than would be possible under any other arrangement; so that any alteration would be a positive disadvantage to the animal." In this—as indeed in all his writings—he takes up a most uncompromising attitude towards the theory of evolution or, as he expresses it, "the unproved hypothesis" of the descent of living organisms from "a supposed common ancestor." He would have none of it.

In 1878 Dr. Haughton retired from the post of Medical Registrar, and became the chairman of the Medical School Committee and University Representative on the General Medical Council.

With regard to his work as a member of the General Medical Council, Sir William Turner writes: "Dr. Haughton, as might naturally be expected, gave especial attention to matters connected with medical education. His speeches on the preliminary or entrance examination of intending medical students were characterised by shrewdness, both of thought and expression, and were enlivened by wit and humour. He held that the entrance examinations to the medical profession should be conducted by the national bodies engaged in general education, and he advocated the importance of mathematics as a mental training. His brightness and warmth of nature made him very popular with his colleagues, who, when his declining health made it necessary for him to resign his seat, expressed, through the President, their regret that he was no longer able to assist them in the discharge of their duties."

As a Governor of Sir Patrick Dunn's Hospital Dr. Haughton likewise did noble work. For thirty-four years he laboured in its behalf, and even during the failing years of his life his interest never slackened, and he rarely missed a Board meeting. The undaunted courage which he showed during the epidemic of cholera in 1866 is not likely to be forgotten. At that time there was most inadequate provision for the proper nursing of the cholera patients in Dublin, and as the disease spread, very naturally the entire nursing machinery broke down. Dr. Haughton called for volunteers from amongst the students and organised from them a nursing staff which did duty during the time that the epidemic lasted. In this work he drew no distinction between himself and the student members of the staff. He took his turn at nursing with the rest; and, by the energetic and enthusiastic way in which he grappled with the difficulty, he did much to alleviate the suffering of the sick and panic-stricken poor in Dublin at a most trying and anxious time. The experience which Haughton passed through during the outbreak of cholera left on his mind an abiding sense of the value of bedside work. He was thus led to found medals for the encouragement of clinical work in Dunn's Hospital, and the last act of his life was, out of very scanty

savings, to provide for the making of these rewards more substantial and permanent.

The Government having thrown open to public competition commissions in the Artillery and Royal Engineers, Haughton was not deterred by his many other duties from organising, in conjunction with his friend Mr. Galbraith, classes for such students as were preparing for these services. The success of their teaching was so remarkable that the proportion of Irish candidates who obtained commissions was higher at that time than it has ever been since, and this success continued until the conditions of the competition were altered to the detriment of University candidates. In connexion with these classes he published with Mr. Galbraith a series of manuals which became text-books for the general use of the College.

No account of the part which Dr. Haughton has played as a prominent figure in Irish life would be complete without reference to his long and intimate connexion with the Royal Zoological Society of Ireland. In 1860 he became a member of its Council, and in 1864 he was elected its Honorary Secretary. For twenty-one years he filled this office, and he only resigned it to assume the duties of President, which he discharged for five additional years. During a large part of the time in which he acted as Secretary the Society was in a very struggling condition, and it passed through more than one financial crisis which threatened to swamp it; indeed it is very probable that had there been a less courageous and able man at the helm the Society would have been submerged altogether. But Haughton never lost heart, and the Society owes its present secure position in a great measure to the plucky fight which he then fought. He enjoyed extremely telling how when the bank on one occasion threatened to foreclose the Society's account, he had met the difficulty by offering to deposit a ferocious Bengal tiger as security for the debt.

He had a passionate fondness for animals. He was never seen in Dublin without his dog; and on his death bed, when lying speechless, he endeavoured with the little power which still remained in his left arm to acknowledge the advances of his little Scotch terrier.

Some of the happiest hours of his life were spent in the Zoological Gardens. A distinctive feature of the social life in Dublin consists in the weekly "Zoo breakfasts." On Saturday mornings the members of Council meet in the Gardens and take breakfast together before proceeding to business. It was at these meetings that Haughton appeared at his very best. Surrounded by friends of long standing, all of whom had the greatest admiration and affection for him, he was wont to give full scope to his bright and joyous nature.

Among Haughton's many talents perhaps the greatest was his

talent for acquiring friends. As we have said, he was singularly unselfish, for if his friends had any fault to find in him it was his little care of his own material interests: he was perfectly transparent and sincere, and absolutely loyal. Thus he kept all the friends he made, and no one was more successful in gaining new ones. He was one of the most charming of companions, overflowing with wit and humour, ready to take a lively part in any discussion, and able from a well-stored memory to relate many results of a much varied experience. And those who were attracted by his social qualities found, as they came to know him better, that he possessed those sterling qualities on which the solid foundations of friendship can be laid. He used to be a regular attendant at the meetings of the British Association, the chief use of which is the bringing of men of kindred pursuits together. There he formed valuable friendships with scientific men, of whom it may be enough to name Tyndall, who came from the same part of Ireland, and Huxley, with whom, though they were widely apart on their theological views, he always maintained a cordial and intimate friendship. His medical friends outside Ireland are too numerous to be mentioned, but he used frequently to speak of Acland of Oxford, Sir William Turner, Sir John Simon, and Sir Richard Quain. It is needless to say how his loss is felt by those with whom he was in the habit of daily working, and it may in truth be said that no man has left a wider circle of sorrowing friends.

He received many honours during his life. Only a few of these need be alluded to here. He was elected a Fellow of the Royal Society in 1858. He received the degree of D.C.L. (Hon. causâ) of Oxford in 1868; the degree of LL.D. (Hon. causâ) of Cambridge in 1880; the degree of LL.D. (Hon. causâ) of Edinburgh in 1884; the degree of M.D. (Hon. causâ) of Bologna in 1888.

It is impossible to give in the space at our disposal anything like a proper conception of the published work of Dr. Haughton. Few men had a greater multiplicity of interests, and although it is probable that if he had been more of a specialist he would have left behind him a larger amount of work of permanent value on some one subject, yet his many-sidedness pre-eminently fitted him for the place he filled in the government of a large educational institution. In the Royal Society Catalogue 173 memoirs and papers are entered under his name, and this only takes his work down to 1883. The majority of these were published in the 'Proceedings of the Royal Irish Academy,' of which he was a member for fifty-two years, and of which he lived to become the President.

Some idea of his amazing versatility may be gained by a glance through the titles of his papers as they are given in the Royal Society's Catalogues. The following is a small selection from these :—

"An Account of Experiments made on a new Friction Sledge for stopping Railway Trains."

"Physiological Experiments on Nicotine and Strychnia."

"On the Sea-Louse of the Baltic."

"On the Reflexion of Polarised Light from Polished Surfaces—transparent and metallic."

"Account of Experiments to Determine the Velocity of Rifle Bullets."

"On the Muscular Anatomy of the Leg of the Crocodile."

"On Hanging, considered from a mechanical and physiological Point of View."

"On Geological Climates."

"On the normal Constants of healthy Urine in Man."

"On the Tides and tidal Currents of the Irish Sea, &c., &c."

"On Slaty Cleavage and the Distortion of Fossils."

Dr. Haughton's contributions to physical science were principally on the subjects of elasticity, the theory of light, solar radiation, and the tides.

Fond of controversy, he plunged into the discussion which raged in the middle of the present century on the nature of transparent media. He very early came to the conclusion (1849) that it was only by a study of the facts of reflection and refraction that the question could be decided, and with this end in view he made a great number of laborious observations on the refraction of polarised light from many substances. The results he obtained remain as a monument to his industry and a permanent contribution to science, although the controversy as to the nature of transparent media has drifted into new channels, owing to the development of the electromagnetic theory of light.

His work on solar radiations was undertaken in connexion with the geological question as to the age of the earth, the causes of the glacial epoch, and of geological climates. By the aid of very laborious calculations he considered the effects produced on terrestrial climates by changes in the distribution of land, by alteration in the temperature of the sun, and by the quantity of carbonic acid and aqueous vapour in the air.

His observations on the tides were originally undertaken with the view of rendering the navigation of the Irish Sea and the English Channel safer to outward and homeward bound ships. He afterwards became a recognised authority on tides, and was not only consulted by Arctic explorers, but was entrusted with valuable records obtained during Arctic voyages for the purpose of report.

Dr. Haughton likewise devoted much of his time to chemical problems, and in the later years of his life some of the higher

mathematical conceptions of chemistry, which he himself called "Newtonian chemistry," greatly engrossed his attention. He endeavoured to develop the consequences of a theory of chemical combination depending on the assumptions that in chemical actions energy was conserved as well as a quantity analogous to areas. Our knowledge of the dynamics of molecules is hardly great enough to criticise such a theory effectively.

Dr. Haughton's work in the field of geology includes contributions upon subjects of a very diverse nature. He has written extensively on mineralogy, petrography, physical geography, and physical geology.

Mineralogy first claimed his attention, and in 1853 he began to publish a series of papers on Irish minerals. One of the last of these dealt exhaustively with the fine meteorite which fell at Dundrum in co. Tipperary, and which through his instrumentality was presented by Lord Hawarden to the Museum of Trinity College.

His petrographical communications are still more numerous and important. His work on the Irish granites is singularly complete, and was commenced in 1856, at a time when the use of the petrographical microscope had not been revived by Sorby. When this is taken into account we cannot help being struck by the results obtained by Haughton.

A highly interesting observation is contained in his papers on the Trap Dykes of the district of Mourne and on the Carlingford Granite. He detects a chemical reaction between the intruding granite and the limestone, and points out how the granite is thereby altered to what may be called a Syenite.

On the subject of physical geology Haughton contributed many papers to the 'Proceedings of the Royal Society' and elsewhere. The first of the series relates to the effect on the distribution of climate in geological time from the shifting of the earth's axis, due to continental upheaval. Haughton arrived at the conclusion—which is in agreement with the views of Professor G. Darwin—that the effect would be insignificant. In a paper which appeared in 'Nature,' Haughton estimated the whole duration of geological time as 200 million years. This opinion he based on the probable rate of formation of stratified rock. He assumed these to possess a thickness of 177,200 feet. He likewise investigated the question of geological climate in connexion with Rossetti's 'Law of Cooling,' and arrived at the conclusion that the secular cooling of the sun has been the chief factor in changes of geological climate.

In 1858 he published in the 'Philosophical Transactions' his important work on the joint-planes of the Old Red Sandstone of co. Waterford, and with this also may be associated his observations on the remarkable uniformity in magnetic bearing of the joint-planes

of these rocks with the joint-planes of Cornwall granite, Donegal granite, the carboniferous limestone of co. Fermanagh, and the granite and slate of Mourne. Daubrée has likewise expended infinite pains on the subject of joint-planes.

Haughton's book entitled 'Lectures on Physical Geography' gives some idea of his marvellous grasp of facts, and of his many-sidedness.

His 'Manual of Geology' is also in many respects a remarkable book.

The chapter on "Symmetry" is specially characteristic of the writer.

Those who read the closing chapter of that book, and who cannot

accept the opinions he expresses regarding Darwinism, will at least

respect the deep and sincere feeling which caused him to reject the

Darwinian philosophy as being opposed to his religious views.

D. J. C.

WILLIAM FRANCIS DRUMMOND JERVOIS was born at Cowes on the

10th September, 1821. In February, 1837, he joined the Royal

Military Academy, Woolwich, and two years later obtained his com-

mission in the Royal Engineers. After passing through the School

of Military Engineering at Chatham, over which Sir Charles Pasley

then presided, he sailed for the Cape of Good Hope. Here he was

soon actively employed. When only twenty-one he was appointed

Brigade-Major to a force sent to the Orange River to control the

movements of the Boers; and in 1846-7 he took part in an expedi-

tion against the Kaffirs. On the latter occasion he made, under

circumstances of considerable difficulty, a military sketch of British

Kaffraria which was of great use in subsequent wars. Thirty years

later it was the only map of the district, possessing any pretensions

to accuracy, which the general commanding could find for his

guidance. In 1848 Captain Jervois returned to England with a

special recommendation from the Governor to Lord Raglan as an

active, able officer who could "afford every information on all military

and geographical points" connected with the colony.

The Duke of Wellington had always held strong views with regard

to the military importance of Alderney, and, in 1852, it was decided

to protect the harbour of refuge, then in course of construction, by

strong fortifications. This duty was entrusted to Captain Jervois,

who designed the works and superintended their construction. Sir

W. Jervois maintained to the last that Alderney was still a place of

importance in the defence of England, but other views prevailed, and

the forts he constructed are now in ruins.

In 1855 Major Jervois was transferred to London and served on

Lord Monk's Committee on Barrack Accommodation. The following

year he was appointed Assistant Inspector-General of Fortifications,

and with characteristic energy at once took up the question of the

defence of our dockyards. He studied the ground at Portsmouth

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