Mr. Meldrum's chief work, at first, was the extraction of meteorological observations from the log of every ship touching at Mauritius, and from this source he amassed a store of facts which he knew well how to utilise. Part of this was employed in the preparation of the cyclone tracks for the South Indian Ocean, a work subsequently published by the Meteorological Council.

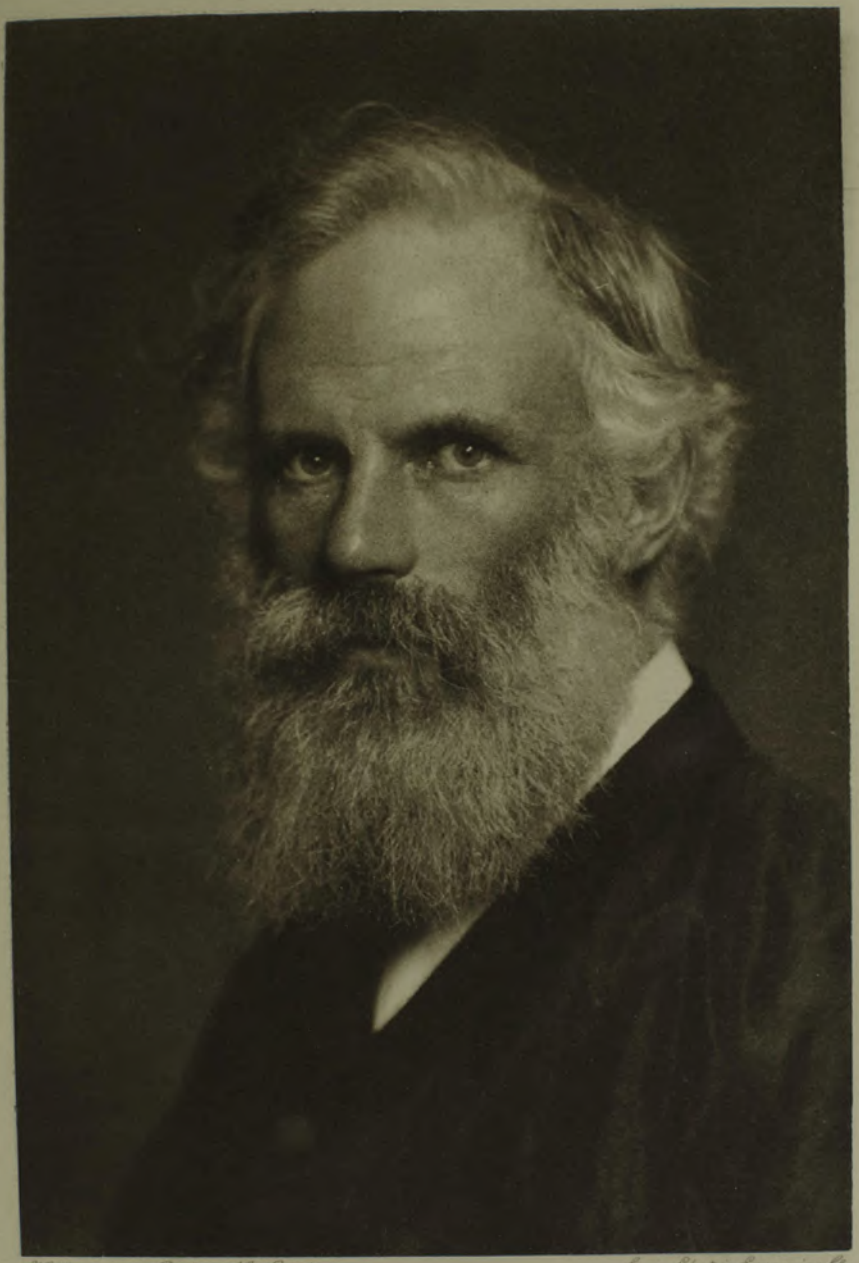
Mr. Meldrum will chiefly be known by the persistent energy with which he studied the connection between the sun-spot period and the recurrence of the cyclones which too frequently devastate the waters round the shores of Mauritius. He early established a system of warnings for the cyclones approaching the island, and these were speedily found to be of value and were implicitly trusted in the port.

Mr. Meldrum received the degree of LL.D. from his own university. He was elected into this Society in 1876, and received the honour of C.M.G. in 1886. He was for ten years a Member of the Government Council of the island. In 1896 he returned to England in very failing health, and after four years of suffering he was at last released in August of this year (1901).

R. H. S.

GEORGE FRANCIS FITZGERALD. 1851—1901.

A thorough attempt to estimate the scientific value of FitzGerald's life and work cannot yet be made: a summary of his published writings can be given, and an indication can be added of the high estimation in which he was held by scientific men in these islands. To the foreigners and to men who have not been brought into immediate contact with him his reputation may seem hardly intelligible; and, indeed, we are often constrained to plead guilty to a sort of family affection existing among British Physicists, and a sympathetic understanding running through our appreciation of them, which tempts us occasionally to be unduly inattentive to some of the first-class work of Physicists outside. It is not a fault on which we pride ourselves: it is one which we lament: it is one which may shortly cure itself, as death removes one after another of those countrymen of the last generation whom we have held in such high honour. The time will doubtless come when with our eyes opened by bereavement, we can estimate in a manner less hampered by intimate insular knowledge the equal achievements of foreigners; but meanwhile we must plead as excuse the extraordinary personal



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Geo. Fras. Fitzgerald

merit and character of some recent Physicists, notably of FitzGerald, in whom those who knew him best could detect least flaw. But foreigners came under the same influence when they were brought into contact with him, witness Ostwald at Leeds, and Lenard at Liverpool; it may be doubted whether there ever was a man of equal scientific power, agility of thought, and selflessness, combined.

George Francis FitzGerald was born on August 3, 1851, and died on February 22, 1901, before he was 50 years of age.

He was the second son of the Rev. William FitzGerald, D.D., afterwards Lord Bishop of Cork, and later of Killaloe: being at the time Rector of St. Anne's, Dublin. His mother was a sister of Dr. G. Johnstone Stoney, F.R.S. He did not go to school, but was educated at home under stimulating circumstances, and to this fact may be attributed some of the retention of his innate originality.

He was not specially remarkable for early ability, as he did not possess any conspicuous faculty for acquiring languages or other learning involving verbal memory; he was good at arithmetic, algebra, and Euclid, of an inventive turn of mind mechanically, and skilful with his fingers in sewing, knitting, and such work; also he developed considerable athletic powers, though he was never specially competent at games.

While still only 16 he went to Trinity College, Dublin, where he soon took a high place; and on obtaining his degree, in 1871, he won the University Studentship, with two First Senior Moderatorships in Mathematics and Experimental Science.

During six years of post-graduate study for the Fellowship, he laid the foundation of his deep and wide knowledge of Physical Science, by study of the classical writings of some of the Masters in Mathematics and Physics, notably Lagrange, Laplace, Hamilton, and MacCullagh. He also made some study of Metaphysics, and was permanently attracted by the philosophy of Bishop Berkeley.

In 1881 he was elected to the Erasmus Smith Professorship of Natural and Experimental Philosophy, vacant by the death of Prof. Leslie; and work gradually began to accumulate upon him. Fortunately he was able to turn his mind readily and persistently to anything that was brought before him, and in the midst of interruption could sit absorbed in either reading or jotting down calculations, sometimes of considerable complexity. But the leisure for long patient analysis was not his, nor did his genius altogether lie in this direction: he was at his best when, under the stimulus of discussion, his mind teemed with brilliant suggestions, some of which he at once proceeded to test by rough quantitative calculation, for which he was an adept in discerning the necessary data. The power of grasping instantly all the bearings of a difficult problem was his to

an extraordinary degree, and it was rare indeed that a thought or a difficulty could be presented to him over which he had not at some period previously brooded. If it were not so, if the ideas were really then presented for the first time, his quickness in seizing them was miraculous. It is easier to suppose that during his long and strenuous course of reading, and in the stimulating mental atmosphere of Trinity College, in conversation also with his uncle Dr. Johnstone Stoney and others, nearly all the problems in physics likely to occur to contemporaries had in some form or other come within his ken; and hence hardly anything that could be suggested seemed altogether new and strange to him. Nor did his knowledge seem to have sunk into any kind of oblivion; there it was always accessible, and with an added commentary of his own quite ready, to the surprise and delight of those who conversed with him.

So, for instance, occurred his perception of the influence of light-pressure in Astronomy; also of the emission by the Sun of electrified particles which streaming past the earth might give rise to magnetic storms and auroræ, before our knowledge of electrons made this idea easy or quantitatively feasible. So also occurred that brilliant suggestion of the change of shape or distortion due to motion through ether, now known as the FitzGerald-Lorentz hypothesis, which flashed on him in the writer's study at Liverpool as he was discussing the meaning of the Michelson-Morley experiment. Of this nature also was his suggestion to utilise the oscillatory discharge of a Leyden jar as a means of exciting ether waves: an idea which roughly had occurred to others before (the writer finds it in one of his own note-books of date 1879—80), but with FitzGerald it became quickly definite, leading him to investigate not merely the easy problem of the wave-length to be expected, but the much more difficult question of the amount of power that would be radiated by an alternating current in any given case.

Directly Hertz's experiments were published, FitzGerald discerned their whole significance, and in his brilliant Presidential address to Section A of the British Association, at Bath, called the world's attention to them in an unmistakable manner. Had it not been for the English recognition they received it is improbable that the work of Hertz would have been hailed with the immediate chorus of universal approbation which it commanded, for the work of his own countrymen had mainly laid on other lines; and even to Hertz himself the theory of Clerk Maxwell only gradually, and subsequently to his verifying experiments, became quite clear and familiar. Undoubtedly FitzGerald recognised more vividly than Hertz himself at that time the full import of his experiments,—the German title of which was far from representing the plain significance of the title

applied by Lord Kelvin to the later English translation, viz., "Electric Waves." This is no disparagement to Hertz: rather it strengthens our admiration of him to perceive how quickly and perfectly he could emancipate himself from national traditions, and constitute himself an apostle, and one of the most powerful exponents, of the Maxwellian Theory of Light.

But to FitzGerald all this was fundamental and familiar—he had got beyond the analysis, and revelled in full-bodied conception and pictorial imagery and mechanical models of what was going on: and these clear perceptions of his, with a realisation of much of the outcome that might be expected, were really of more value and contributed more to the progress of science than did his own laborious analytical investigation of the Electro-magnetic Theory of the Reflection of Light from Insulators, from crystalline bodies, and from magnetised media, which constitutes his chief systematic memoir: powerful and impressive as the complete mathematical analysis of so difficult a subject necessarily was.

Another aspect of the man was his extraordinary and sympathetic critical power. He did not seem to mind reading other people's papers and proofs: entering into their point of view seemed to him to present no difficulty, nor did the immediate correction of blunders into which they might have fallen seem to present any difficulty, or suggest any claim to superiority.

As an ordinary man could correct a schoolboy's sum, or an exercise in simple mechanics or geometry, so he could tackle a difficult Royal Society paper, or a Treatise, say on Thermodynamics or on Physical Chemistry, and point out both the merits and flaws in it at once. Never was anyone so clear on the subject of the pitfalls which once awaited the unwary chemist or applier of the second law of Thermodynamics to physical and chemical problems. The result being correct, or at least acceptable, it is so easy to bolster it up by a false application of quasi-mathematic or thermodynamic reasoning; but all such fallacies were instantly detected by FitzGerald, and the essential requirements of both reversible and cyclical processes, as the basis of systematic theory, insisted on.

Suggestions for experiment frequently occurred to him, but were seldom carried out with his own apparatus; rather he preferred to hand on both the labour and the honour of an experimental research to some assistant or student, to whose reputation a successful result would make all the difference; and many results obtained by others probably owe their initiation to him.

By reason of these peculiarities of disposition his published memoirs may not impress foreigners, or those who did not know him, with a proper idea of his real magnitude; but it is probable

that they will nevertheless produce a very considerable impression. For so many of his contributions to science were made to the Royal Dublin Society (of which he acted as Secretary from 1881 to 1889) or orally to the British Association, neither of which agencies are specially well adapted for informing the world generally, that to many the memoirs which will shortly be published, under the careful editorship of Dr. Larmor, will be new, and will come as a revelation of solid and industrious work.

Nevertheless, once more it must be said that his wide knowledge, and brilliant speculations based upon that knowledge, were what impressed his friends the most. Sometimes they seemed almost too fanciful, too far-reaching ahead of solid fact, too intangible and fantastic to be attractive; that is the case to some extent, for instance, with parts of the Helmholtz Lecture, where the beauty and the possibilities of the vortex hypothesis of the constitution of matter and of the structure of the ether entice him into regions where substantial mathemathical progress is hardly yet possible. Into this region, however, the human race must advance, if it is to proceed with the unification of matter and the more fundamental understanding of the material universe; and our descendants—the possessors of an elaborated theory—will be able to judge better than we can how far these speculations of FitzGerald were fantastic imagination, and how far they were the outcome of a real and semi-inspired insight into the inmost processes of Nature.

But in spite of his ready absorption in these physical topics and his almost unique power of quickly grasping and fruitfully dealing with them, he was imbued with a sense of the far greater importance of humanity itself than of any of these material things. In fact it was this constant feeling of the value of human relationships, and the supreme influence of good feeling and affection, that led him to regard all questions of priority or of scientific credit with not so much disdain as absence of interest. It is easy to say that provided a discovery is made it matters little who makes it, but it is not so easy constantly and consistently to feel and act in that spirit; but so far as it can be done FitzGerald did it, and did it apparently almost without an effort. The things he really valued were the things belonging to the human spirit—the development of the individual and the development of the race. Any thing which hindered this met with his strenuous opposition: self-satisfied unprogressiveness in educational matters excited his wrathful and outspoken indignation: and on these subjects alone did he occasionally make enemies. Other things might be of intense interest but were not of supreme value and to sacrifice any personal relationship to them was worse than useless.

With all his critical power he seldom expressed himself severely on the scientific mistakes of others. I have once or twice heard him speak of some man as small or narrow, and I have heard him wax indignant over some charlatan who pretended to be what he was not; but these were exceptional instances, and as a rule this mood had to be worked up by others: it did not arrive spontaneously. Generally he saw the best in people; and, like Lord Kelvin, was able to disentangle ideas of value from the crude efforts at presentation of a beginner or of an ordinary muddle-headed man.

Gradually as he grew older the sense of public duty grew upon him, and he was prepared to spend his time in public service to an extraordinary, and as some thought a wasteful, extent. In 1888 he was appointed a member of the Board of Irish National Education, and devoted a large amount of time to work not free from controversy; and shortly before his death he was appointed, with five others, to the Intermediate Education Board. Had he lived (he has written to his uncle, Dr. Johnstone Stoney) he would have sought to devote himself to the organisation of National Education rather than to the uninterrupted pursuit of his science,—saying with complete sincerity that whether the human race got to know about the ether now or fifty years hence was a small matter, but whether the present state of appalling scientific ignorance was to continue for another generation was a vital matter affecting the future of his own country in a positive and definite way.

The portentous backwardness of this country (not Ireland alone) in education does indeed call for sacrifice on the part of those who clearly realise it; and into this work FitzGerald would undoubtedly have thrown himself. Until a general level of scientific knowledge has been attained by a nation, it cannot expect its great men to forge on ahead and continue their advanced studies with satisfaction to themselves. Already they have been feeling too isolated and aloof from humanity, and a feeling of the futility of it all, based upon the entire uncomprehension of the multitude—an uncomprehension shared under our present system of education by the great bulk of so-called educated men,—is apt to make itself unpleasantly prominent every now and then, and to lead gradually to the belief, at which FitzGerald arrived, that greater service could be done by working towards the raising of the general level than by a pioneering quest, solitary or with only a few like-minded spirits, into lands too far removed from human traffic to be capable of utilisation and absorption for generations to come; perhaps, therefore, to be forgotten and ignored altogether, until re-discovered independently hereafter, at a time when the general level of intelligence in scientific directions shall be higher than it is now, and can enable it to be appreciated and retained.

The authorities of Trinity College, Dublin, are bringing out a memorial edition of FitzGerald's writings, under the supervision and editorship of his friend and equal, Dr. Joseph Larmor; who has likewise written a powerful general summary and estimate of his scientific work, so far as it can yet be estimated, for the *Physical Review* for May, 1901; which will be reprinted with notes and additions in the volume of FitzGerald's collected works. To this memoir the student of advanced Mathematical and Physical science is referred. It is thought better to restrict this present notice to matters of more general interest, but it may be permissible to conclude with a few quotations from the pen of some of his contemporaries, Heaviside, Ramsay, and others, which appeared at greater length in the pages of *Nature* for March 7, 1901:—

"At the last meeting of the British Association (at Bradford, 1900) the proceedings of the Physical Section were interesting and successful from one cause beyond all others—the assiduity with which he devoted himself to attendance, and the unceasing flow of valuable suggestion and appreciative criticism which he contributed. His stores of knowledge were ripening and maturing in fibre year by year; his memory was unfailing, and each new fact or phenomenon seemed to find its place at once in the setting to which it belonged. Whatever views were presented to him, however much they jarred with his own ideas, were certain to receive patient and careful consideration. There was nobody who did more to encourage younger men and to bring out what was best in them; the time which he was accustomed to devote without stint to the elucidation and improvement of the work of others sadly diminished the opportunities for work more especially his own. His advice and judgment were valued over the whole range of Physical science, not less in foreign lands than at home, notwithstanding that he published so little. When a Physicist or physical Chemist came to a puzzle or paradox, or was in doubt between various plans of procedure, it seems to have come to be almost the natural course to write to FitzGerald. A letter of inquiry or criticism always elicited a prompt reply, entirely devoid of pretension to magisterial authority, but certain to bring out new aspects of the subject and exhibit its connection with other problems. He was constantly acting as referee of scientific papers for the Royal Society and other bodies, and was accustomed to interest himself in them as if they were his own work." J. L.

"He had, undoubtedly, the quickest and most original brain of anybody. That was a great distinction; but it was, I think, a misfortune as regards his scientific fame. He saw too many openings. His brain was too fertile and inventive. If he had been less

quick and versatile and more plodding he would have been better appreciated, save by a few." O. H.

"FitzGerald had no trace of intellectual pride, he never put himself forward, and had no desire for fame; he was content to do his duty. And he took this to be the task of helping others to do theirs. Although he held strong views on many points, and could defend them with vehemence, his argument was never a personal one; and it was obvious that he was actuated solely by a love of truth, and that his only object was to defend what he thought to be right. Moreover, what FitzGerald thought to be right was pretty sure to turn out right in the long run." W. R.

From an obituary notice in the *Electrician* for March 1, 1901, the following:—

"He possessed extraordinary versatility, and could turn his mind almost instantly to anything, but the instant it was so turned it went deep into the subject, to the exclusion of other things for the moment; and in the deepest subjects he was more at home than in the trivial and superficial. But he was never a recluse; had he been more of a recluse perhaps his great power of intimate brooding and absorption, combined with his wide mathematical knowledge and preparedness, might have led him to some epoch-making discovery. But if so he did not give himself the chance, his place was with the captains and the shouting, and the intervals of leisure for real continuous work were few and far between." O. J. L.

A communication from Lord Kelvin, which appears as the conclusion of Dr. Larmor's memoir above referred to, shall not have an extract removed from the context.

But on the personal side, the following extract from an appreciation in the *Athenæum*, attributed with some probability to Professor Mahaffy, may be quoted:—

"His appearance was not unworthy of his fame. More striking he was than handsome; but his ample grey locks and beard, his furrowed brow, his penetrating eyes, reminded one of the bust of some Greek philosopher, which we cannot look upon without that instinctive feeling of respect which intellect and character command among civilised men."

And the following by Larmor:—

"His scientific place will be henceforth alongside Rowan Hamilton and MacCullagh and Humphrey Lloyd, and the other famous men who have secured for the Dublin school so prominent a position in the edifice of modern physical science. In the higher domain of heart and conduct the recollection of his qualities will be an abiding treasure to all who knew him."

FitzGerald was elected a Fellow of the Royal Society in 1883, and

in 1899 was awarded a Royal Medal. He married, in 1885, Harriette M., second daughter of the late Rev. J. H. Jellett, D.D., Provost of Trinity College, Dublin, to whom the next previous award to an Irish man of Science of a Royal Medal had been made. One who had unrivalled opportunities of appreciating these two men remarks on "the great likeness in the two characters: the great simplicity, the directness of purpose, the utter absence of preaching but the living of the life that is best; their great tenderness and love of children."

The "idealistic" turn of his mind in dealing with ultimate questions came out constantly in his conversation on such topics, and may be illustrated by a quotation from the end of his Helmholtz Lecture. After noting that all forms of external stimulus, into whatever terms we translate them—sound, colour, and the rest, nay, even space, time, and substance too, perhaps—resolve themselves into motion, he goes on to ask: "And what is the inner aspect of motion? In the only place where we can hope to answer this question, in our brains, thought [turns out to be] the internal aspect of motion. Is it not reasonable to hold, with the great and good Bishop Berkeley, that thought underlies all motion" . . . . . "For the highest life we require the highest ideal of the Universe to work in. Can any higher exist than that, as language is a motion expressing to others our thoughts, so Nature is a language expressing thoughts, if we learn but to read them."

He insisted on the ether being not a simple fluid, with the atoms as vortex rings, but a medium itself full of motion,—a vortex "sponge" or assemblage of vortex filaments; and by help of such a medium he hoped ultimately to be able to explain not only light and electricity but the structure and properties of matter, all its physical and chemical agencies, and the material universe generally. But always he was well aware that such would be no ultimate explanation, that what we are really and primarily aware of is mind and mental processes, that thought and feeling are primary facts of consciousness, while all else is an inference and is probably essentially unlike what it appears to our senses: so that all this cosmic whirl and material activity, and probably life itself, would resolve itself, when properly comprehended, into the activity of an all-pervading and beneficent Mind.

O. J. L.