Ernest Thomas Sinton Walton: Nobel Laureate

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ON NOVEMBER 16, 1951, the Swedish Royal Academy of Sciences announced the award of the Nobel Prize in Physics to Ernest Walton and John Cockcroft, ‘For their pioneer work on the transmutation of atomic nuclei by artificially accelerated atomic particles.’ Transmutation is the changing of one atomic species into another, which occurs routinely in nature in the decay of radioactive materials. To the world at large, Walton and Cockcroft were the first to split the atom – or more accurately the nucleus - in a controlled way in the laboratory. The experiment was carried out in the Cavendish Laboratory in Cambridge where Walton started out as a Ph.D. student working under the supervision of the renowned Sir Ernest Rutherford, later Lord Rutherford. As a result, they were catapulted into that élite group of scientists who shaped the development of modern physics in the early decades of the twentieth century.

Within the annals of Trinity College, Walton propagated the legacy of those other world class Trinity scientists, engineers, mathematicians and medics who spectacularly enhanced Ireland’s scientific reputation in the 1800s: in science and mathematics, we immediately think of Sir William Rowan Hamilton, Bartholomew Lloyd, James McCullagh, George Francis FitzGerald and John Joly. Their contributions spanned the full spectrum of fundamental science, applied science and technology, pedagogy and administration.

Lord Kelvin, in his address during the College’s Tercentenary celebrations in 1892, remarked:

> ‘I do not think that there is any other university in the world of which it can be said that four of the Provosts that have presided over it during the short period of a century have, every one of them, contributed magnificently to the advancement of Science.’

Many believed in the late 1800’s, including Kelvin, that there was little else to discover in science. As it turned out, that period heralded a further major leap forward in scientific understanding with the discovery of radioactivity, X-Rays, the elucidation of atomic structure, and the formulation of new theories which were radically to reshape scientific thinking.

Ernest Walton’s life experiences as a scientist, educator and humanitarian bridged that watershed period of scientific discovery with the burgeoning explosion of new knowledge which we are currently experiencing.

As to the man himself, Ernest Thomas Sinton Walton was born in Dungarvan, County Waterford, on 6 October 1903 to Anna Elizabeth and John Arthur Walton, who was a Methodist minister. Three years later his mother died and, in time, his father married Mary Elizabeth Kirkwood. Ernest Walton’s half-brother, the late Professor James Kirkwood Walton of the English department, was born in 1919.

I once asked Ernest Walton what part of Ireland he came from:

> ‘I don’t really know; I was born in Dungarvan in Co. Waterford, I lived in Rathkeale for a while, I lived in Castleblayney for a while. All my school days were in the north of Ireland. In those days, a Methodist minister was changed around every three years …. And the result was that you moved to a great many different places. I think my home was in nine different towns in the north of Ireland and four or five in the South. Being in school in Northern Ireland naturally I picked up a northern accent.’

He later remarked that he didn't like the sound of his own voice but that was something he had to live with.

His formative years corresponded to a period of exceptional global and national upheaval with the First World War (1914-1918), the Easter Rising in 1916 and the foundation of the Irish Free State in 1922 with its subsequent bitter civil war. Further radical developments in science, nonetheless, continued to gain momentum during that time. But more anon.

These years also witnessed the emergence of changing social values and a disturbing negative perception of science in Ireland in the run up to independence and thereafter, reflecting in part the realization that the Anglo-Irish ascendancy was largely responsible for much of Ireland's pre-eminence in science and mathematics. A growing separation of scientific and literary pursuits was in keeping with an emerging 'cultural duality' or 'Celtic revival', promoted by such influential people as W. B. Yeats who served for a time in Seanad Eireann. As a result, the tradition of creative scientific endeavour was impaired by major social, cultural and educational transformations. Science teaching in schools regressed as a result.

The family's constant change of residence also influenced the manner in which Ernest Walton pursued his primary and secondary education. In his early years he attended schools in Banbridge and Cookstown before his seven years as a boarder in Methodist College, Belfast, from 1915 to 1922, where he excelled in science and mathematics. In those days Methody showed great foresight in emphasizing the importance of practical science in the school curriculum at a time when it wasn't particularly fashionable to do so. Belfast also at that time was one of the world's leading industrialised cities, bestowed with a highly developed entrepreneurial and inventive culture which created an ambiance of innovation and creativity in the minds of those sensitive to such stimuli. Walton was one such person.

After completing his studies in 1922, Walton was faced with a dilemma: Should he opt for Queen's University on his doorstep in Belfast, or his father's Alma Mater, Trinity College Dublin. His decision was as much dictated by financial as by purely academic considerations.

Having completed the Queen's entrance scholarship examination, he was due to travel to Dublin to sit the sizarship exam in Trinity when events took an interesting turn. Walton himself takes up the story:

> We finished the Queen's entrance scholarship and I went along to the railway station to get the train to Dublin and I was refused a ticket. I was told the reason was that the civil war had broken out in Dublin and no trains were running. There was another chap there who also wanted to go to Dublin for the same reason. That other chap who came from Ballymena was A. J. McConnell, later Provost of this College. He too was refused a ticket.

In the event, the College held the sizarship examination later that year for those who couldn't travel to Dublin. The upshot was that Walton, with an Armagh scholarship also in hand, had the choice of either university and opted for the joint science and mathematics route in Trinity. McConnell, in his turn, had won the County Antrim scholarship.

The Physics Department at that time was served by one Professor, William E. Thrift, and two Assistants: One was his brother Harry Thrift, a colourful character who was a noted rugby player, lining out for Ireland on eighteen occasions as a wing three-quarter, and who featured in Joyce's *Ulysses*, as a cyclist and athlete in the Trinity Races of 1904. The other was John Hewett Jellett Poole, grandson of a former Provost of the College - or Jackie Poole as he was affectionately known to us all. My own appointment in the department in 1967 filled the vacancy created by Jackie Poole's retirement.

In their undergraduate years, Ernest Walton and Albert McConnell garnered most all of the available prizes. Upon graduation in 1926, Walton decided to pursue a Master's degree by research in hydrodynamics for which he was awarded the McCullagh prize in mathematics. This project was suggested by Professor J.L. Synge, a member of the Synge family which included the playwright John Millington Synge and the lesser known, but no less brilliant, Edward Hutchinson, or 'Hutchie' Synge of whom we will hear more at a symposium in College this coming Thursday.

Walton was now one step closer to achieving his ultimate ambition of pursuing research in the Cavendish. He recalled:

> I was anxious to get to Cambridge which was the place to go because there were so many famous physicists there at the time and of course Cambridge had a long history of mathematics and physics. After all, it was the College and University of Isaac Newton and you cannot get much higher than that.

Having been awarded an 1851 Exhibition Overseas Research Scholarship, Walton duly applied to Rutherford for admission to the Cavendish but was rejected on his first attempt because of the already gross overcrowding in the Laboratory. However, he later succeeded following the intervention of Jackie Poole and John Joly who knew Rutherford personally.

Walton often spoke of his amusement in locating the Cavendish when he first arrived in Cambridge remarking that 'it was an unpretentious building tucked away up a side street and no passers-by seemed to have heard of it.' However, some of the greatest discoveries in science were made within those walls, which had led to the award of no less than four Nobel prizes with another five to come, two of which were those of Walton and Cockcroft. These included the discovery of the neutron by Sir James Chadwick and the electron by J. J. Thomson, the electron so named earlier by the Irish scientist and Trinity graduate, George Johnstone Stoney. For Walton, the stimulating and creative environment in the lab under Rutherford's guidance lived up to his greatest expectations.

When Walton arrived in the Cavendish, progressively greater insights were evolving on the structure of the atom. Rutherford's early experiments on radioactivity, for which he had won the Nobel Prize in Chemistry in 1908, exploited nature's gift of alpha particles which are charged helium nuclei, being one form of radiation emitted in the radioactive decay of such elements as radium. He used these highly energetic atomic particles as projectiles to bombard target atoms under investigation and to monitor their subsequent behaviour. From these experiments Rutherford deduced that atoms comprised, to simplify somewhat, a tiny dense central core or nucleus surrounded by a spherical cloud of spinning electrons. Niels Bohr later refined the model by describing how the electrons moved in defined orbits, somewhat like a miniscule solar system, around the nucleus.

To put these experiments in context, we might ask, how big is an atom and a nucleus? The answer brings us truly into the Lilliputian arena of science where the size of atoms is typically measured on a scale of 10,000 millionth of a metre with the nucleus of the order of 100,000 times smaller again. In reality, the atom was largely made up of empty space. At that time, the nucleus in the atom was rather fancifully compared to 'a fly in a cathedral' or, as Rutherford put it, to 'a gnat in the Albert Hall'.

Now, these experiments were exceedingly difficult because alpha particles were in very limited supply and, in discussion with Rutherford, Walton suggested the generation of streams of fast particles in a controlled way in the laboratory as an interesting research project.

Rutherford readily agreed and Walton set to work. Most of the component parts of the apparatus designed for the task in hand had to be made from scratch, often from the cast-off bits and pieces from other projects in the laboratory. Contrary to what one might have expected at that time, the Cavendish was an intellectual powerhouse but with very limited resources. As Walton recalled, ‘I was very surprised when I went to Cambridge to find out that [like Trinity College] they were poverty-stricken too.’
Walton’s highly developed practical ingenuity and manual skills were accordingly of considerable importance in tackling the problem of building an apparatus capable of producing particles with the energy needed to penetrate the nucleus. Without going into too much detail, this required access to an extremely high accelerating voltage source, initially thought to be in the millions of volts range - a truly daunting, if not impossible task to construct such apparatus in a normal laboratory.

However, in 1928 the story took a rather unexpected twist with the visit of George Gamow, the famous Russian theoretical physicist, who argued that the formidable repulsive barrier which kept the nucleus intact could be breached by tunnelling though it rather than jumping over it. In discussions with Gamow, John Cockcroft surmised that light particles such as hydrogen nuclei – protons - could tunnel into the nucleus, using much lower and more manageable accelerating voltages than initially envisaged.

In a master stroke Rutherford put Cockcroft and Walton to work jointly on the project which came to fruition on April 14, 1932, precisely eighty years and two days ago, when atoms of Lithium, the third lightest element, disintegrated into two alpha particles when bombarded with high energy protons using voltages that were significantly lower than first expected. Walton takes up the story:

> This happened one day in April, 1932. Cockcroft was not in the room at the time. He was doing some work for Kapitza [another renowned Russian scientist] in the Magnetic Laboratory. When I got up to the high voltage and put on the proton current, I thought I’d like to see if anything was happening. We had rigged up a scintillator screen of willemite [a naturally occurring mineral]. If there were any fast particles coming out of the apparatus they would produce scintillations [or flashes] in this material. I left the control bench – the apparatus was giving voltages of something of the order of six or seven hundred thousand volts – and I crawled across the room on my hands and knees in order to avoid the high voltages and went into a little hut that we had built under the apparatus. … When I looked in through the microscope I could see a whole lot of little stars suddenly appearing and just as suddenly disappearing. Well I knew that this was the sort of thing that happened when alpha particles struck this willimite material.

Walton then sent for Cockcroft and Rutherford who confirmed his observations. Rutherford concluded that ‘those scintillations look mighty like alpha particle scintillations’ produced by the disintegration of lithium which was confirmation indeed because Rutherford had discovered alpha particles many years earlier and had given them their name.

Walton himself was the first to witness the transmutation of an atom by artificial means: he was at the birth of the new era of accelerator-based experimental nuclear physics which is now pursued at many research establishments around the world, with CERN as one notable example.

Walton and Cockcroft had, in fact, achieved what was previously considered to be impossible. Some short time before their success, Albert Einstein had remarked that splitting the atom was indeed an impossible task: 'It would be like a blind man trying to shoot ducks, firing into the air in a country where there were very few ducks.'

The Walton-Cockcroft experiment however had used a far greater number of atomic projectiles than nature could provide and only one target atom in every one thousand million was split: so Einstein's instinct was not that far off the mark!

The experiment confirmed a number of predictions arising out of the theory of relativity and the new quantum mechanics, including Einstein's own famous equation, $\mathbf{E} = \mathbf{mc}^2$, where **E** denotes energy, **m** denotes mass and **c** is the velocity of light. The equation stipulates the direct equivalence of mass and energy and that mass and energy were, in fact, interchangeable.

We note in passing that $E = mc^2$ gives us direct insight into the sheer magnitude of nuclear energies: multiply even a very small mass m by the speed of light c which is 300,000,000 m/s, and do that twice: you will end up with a very large energy indeed.

The apparatus finally developed by Cockcroft and Walton was the result of exceptional technical ingenuity, painstaking development and an ability to design and construct components which were not available commercially: It was truly 'a triumph of ingenuity over adversity' with two complementary talents working in unison, for which they were jointly awarded the Royal Society Hughes Medal in 1938. The original apparatus is on view in the Science Museum in South Kensington in London and there is a replica in the Smithsonian in Washington DC.

On a more personal note, Walton's private papers included a most insightful letter to Winefrid (or Freda) Wilson, a fellow Methody student who was to become his future wife, and who at that time was teaching in Waterford. The letter was sent to her some days after the momentous experiment.

> 'Last Thursday was a red letter day for me. Not only did I get a letter from you but Cockcroft and I made what is in all probability a very important discovery in the lab. … Rutherford suggested that we keep it a dead secret between the four of us until we publish an account of it in next Saturday's 'Nature'. … We know that people in the States are working along similar lines and Rutherford would like to see any credit going to the Cavendish. He is not fond of American physicists in general on account of their tendency to do a great deal of boasting about very little. …'

Nor did the event escape the attention of those at home. An editorial in *The Irish Times* of Tuesday, May 3, 1932 highlighted both the fascination and the apprehension in the minds of some, on the announcement:

> We announced yesterday that two young men of science, working in the Cavendish Laboratory in Cambridge, had "split" the atom. Lord Rutherford, the director of their experiments, is cautious and reticent – as true research always is – but he admits that Dr. J. D. Cockcroft and Dr. E.T.S. Walton have made a "discovery of great scientific importance." …. The plain man knows only that science has been striving in recent years to release and control the stored vigour of the atom – as in earlier ages it pursued the Philosopher's Stone – and that the "splitting" of the atom was an essential factor of success. He has read novels in which the man who "split" the atom became master of a destructive force that enabled him to hold the world to ransom.

The article continues:

> While Lord Rutherford's announcement is silent upon such horrific possibility, "it is difficult," he states, "to say to what this discovery may lead." Hitherto the experiments have not yielded results of immediate commercial value, but "they are likely to be powerful agents in extending our knowledge of the atom." Lord Rutherford's careful words suggest that a page, not only new but momentous, is being turned in the story of scientific progress. It must be a cause of pride to all Irishmen that one of the two victors of the atom – Dr. E.T.S. Walton – is a young graduate of Dublin University.

Provost E. J. Gwynn's letter of congratulation to Walton explained the prevailing position in Trinity as well as providing some interesting insight into the state of the nation in 1932:

> …. I had hoped that we should have been able this term to arrange definitely for offering a Fellowship in Experimental Science in which you might perhaps have been interested, and I still hope that we shall be able to do so. But just for the present our plans are held up by the political disturbance in the Free State. The Board feel that it would be useless to offer a Fellowship with the hope of attracting competitors from England at a time when the future position of this country is so uncertain ….

In the event, Walton was awarded his Ph.D. in 1931, and stayed on in Cambridge for a further three years until 1934 with a Senior Research Award from the Department of Science and Industrial Research and a Clerk Maxwell Scholarship. Cockcroft and Walton were the toast of the global scientific community and, in 1933, were invited to the Solvay Conference in Brussels which was attended by many of the great scientists of the day, including Rutherford, Bohr, Lawrence, Gamow, Fermi, Heisenberg, Langevin and Marie Curie.

Walton would have been welcomed in any of a number of leading laboratories around the world but, instead, chose to return to Dublin in 1934 as an elected Fellow of Trinity College in the Department of Physics headed by Professor R.W. Ditchburn. At that time a Fellow's salary was £440 per annum plus additional remuneration for examinations. The conditions under which he decided to accept a permanent post in Ireland at a time of acute economic austerity certainly resonates with our current employment situation. 1934 was also the year in which Ernest Walton married his beloved Freda Wilson.

After Irish Independence, funding for universities was minimal, and particularly so for Trinity College which did not receive a state grant until the Dáil allocated £35,000 to the College in 1947 in response to an approach by the College in the previous year. At that time de Valera shared a common interest in mathematics with Albert McConnell and a good rapport had developed between them. In his lecture celebrating his 50 years as a Fellow in 1984, Walton recalled the dire financial position of the department in those early days:

> Eventually Physics was allocated an annual amount of £460 for apparatus and ordinary running expenses. But we didn't really have £460 to buy much because the wages of our only technician, Tom Flood, had to be paid out of this. He got about £220 a year so we were left with about £240 to look after all our needs.

Thus, the budget for running costs was approximately half a Fellow's annual salary! It was quite some time later that a full-time secretary was appointed from central funds. The situation was further exacerbated by heavy teaching loads, tutorship and examination duties which seriously curtailed the time available for research. Walton and his colleague Bobby Elliot had, however, made progress in constructing an operational accelerator, the central part of which is on display in the Physics department, but its application to research problems was stifled with the advent of World War II.

The war years were particularly onerous for Ernest Walton, due to a lack of research funds and, equally important, lack of time to do research. Professor Ditchburn, the head of department, like many others, had departed for England early on to assist in the war effort which reduced the staff complement in the Physics Department to three. At that stage Walton was lecturing up to 17 hours per week. In addition, an Emergency Research Committee had been set up by the Government to deal with a range of national problems, mostly arising out of shortages such as domestic and motor fuel. As a result, available research time was redirected to their solution.

During the war, Walton was approached by C. P. Snow of the British Ministry of Labour and National Service in February 1941 to participate in war work. His refusal to do so was the following: 'My answer has been long delayed as I have been torn between various loyalties … my duty is to remain in Ireland to help.' Later he was again approached with a further, more unusual and somewhat mysterious, request as he explained:

> I was rung up by Chadwick, Sir James Chadwick, one day wanting to know would I join a group of people who were going out to the States. So I questioned him about it and he explained to me that he couldn't tell me what it was about. I [then] got this letter from him which came in through the British Office here in Dublin – it was before the time we had a British Ambassador here [the first arrived in 1950] – wanting to know if I would join a group of people going out to America on war work, and he said in the letter that he could not disclose what this war work would be about. Well I wasn't very keen on going and I consulted the Provost about it. Provost Alton wouldn't hear of me going because Ditchburn had gone over to do war work [in England]. If I had gone it would have left two people to run the department. So I was pleased about the Provost's refusal and I could write back to Chadwick and explain that it wasn't possible to let me go. Well of course later on I realized what this job meant; it was the organization working on the atomic bomb [the so-called Manhattan Project].

To be asked to join such an élite group of scientists was a clear indication of Walton's stature among the global scientific community at that time. While his decision not to participate in 'war work' was not entirely his own, he did hold strong pacifist principles. His sense of duty to the College as a Fellow and his commitment to Ireland were also very important considerations. The enormous media publicity accorded to the 1932 breakthrough had been alarmist, associating the splitting of the atom with the atomic bomb. Walton was always at pains to stress that he did not feel in any way responsible for the subsequent development of nuclear weapons. The general public's tendency to associate 'splitting the atom' with nuclear reactors and bombs, was not accurate, as Walton explained.

> There were two discoveries essential for the atomic bomb. There was first of all the discovery of the neutron by Chadwick and then, secondly, there was the discovery just at the beginning of World War II of the fission of uranium which is essential for the atomic bomb.

On the more fundamental question of working on the Manhattan project, Walton's views expressed in February of 1963 to the Dublin Jewish Students' Union on the 'Moral Aspects of the Atomic Bomb' revealed his position on this issue. Conceding at the outset that his views were little more than groping in the dark, he raised a number of conflicting issues as matters for debate: He was conscious that nuclear war is all-out war with no possible gradation of force and that, compared to conventional warfare, there was a leap in the magnitude of both controlled and uncontrolled damage inflicted with persistent serious after-effects. Walton accordingly identified three positions: complete pacifist, complete militarist, and 'nuclear pacifist', all of which he considered to be logical up to a point. He held the personal view that he would like to be a pacifist but would nonetheless have difficulty with that position in certain circumstances. On balance, he was strongly committed to minimising the threat of nuclear war and banning the bomb – hence his membership and Presidency of the Irish Pugwash Group whose goal was precisely along those lines. Walton did support the case for a just war which was fought justly. Thus, it is reasonable to conclude that he was, in his own words, a nuclear pacifist.

After the war, when Ditchburn chose to remain in England, Ernest Walton was duly appointed the eighteenth Erasmus Smith's Professor of Natural and Experimental Philosophy in 1946, a post which he held until his retirement in 1974.

As a lecturer, Walton was unrivalled in the way he could present even the most complicated concepts in clear and readily understandable terms, often aided by demonstrations which reflected the same level of ingenuity that characterized his experimental work in Cambridge. He was truly a master of the lecture-demonstration. Our colleague Cyril Delaney summed up his key strength as follows:

> As a physicist, he has the attribute found in all of the great physicists I have ever met in that he understood the simple things very well. We can all blind one another with science, but the simple things are harder to see.

Walton's own early experience in Trinity College as an undergraduate also prepared him well for maintaining order in large classes, not as one who wielded authority but as one who earned the respect of his students. He occasionally saw the humorous side of lecturing, that is, humorous for the lecturer but not always for the student, as typified in one large Freshman class. Picture the scene: Walton is writing at the blackboard; a precocious student – and there is usually one in every large class - decides to roll a steel ball bearing down the steps of the large, tiered lecture theatre; Walton continues to write on the board uninterrupted while counting the number of audible bounces; he then retrieves the ball bearing and retraces the requisite number of steps by which time the red-faced student is readily identified and duly admonished not to repeat the prank again, much to the delight and cheers of the rest of the class.

Throughout his professional career, Walton was occasionally asked to speak on the relationship between science and religion. As a committed Methodist, his own approach to life was guided by an unwavering commitment to the fundamental tenets of his Christian faith. That said, his approach to the subject was cautious, viewing himself [and I quote] 'as only a practical physicist who had never made a study of the philosophical or religious implications of science [but added], after all physics is basic to our understanding of the material universe of which we form a part.' He argued that there was a continuous revelation of God through science in probing the wonders of nature and the original act of creation and, 'we must pay God the compliment of studying his work of art.' He considered, however, that doctrine and dogma were counter-productive in science since they reflected a closed mind. As to the relationship between science and religion, Walton argued that 'scientists seek truth, Christians seek truth, and, in the end, truth cannot conflict with truth.'

The outstanding event in the history of the Physics Department was, of course, the award of the Nobel Prize for physics jointly to Ernest Walton and John Cockcroft in 1951. This was the first, and to date, the only Irish Nobel Prize in science, complementing Ireland's four prizes in literature and five in peace.

Following the announcement, the Waltons were hosted to a lunch in Áras an Uachtarain by President Seán T O'Ceallaigh and, later that week, they travelled by boat to Sweden. On their arrival in Gottenberg, Walton faced a barrage of reporters wanting an interview with the new British Laureate. He immediately corrected world press reports by asserting that he was Irish and not British.

The award of the Nobel Prize by the King of Sweden was scheduled for December 10 followed by a banquet. As a prelude to the Nobel Banquet speeches, Einar Löfstedt, member of the Swedish Royal Academy of Sciences addressed the Laureates, stated:

> Brilliant, too, is the work that has been carried out in the field of nuclear physics and nuclear chemistry by this year's four prize-winners. You, Sir John Cockcroft and Professor Walton, have, at an early stage, through your ingenious ideas and experiments, pointed the way to fundamental enlightenment on the structure of atomic nuclei. You have thereby opened up an extremely fruitful field of research, which has since been ardently developed and which at the present day is of greater current interest than ever. No less an authority than Lord Rutherford has said with reference to your work: it is the first step which counts. You have done a real pioneering work, and we are glad to see it crowned, not only by fame, but also by the Nobel Prize.

The Methodist congregation in Sweden had a special welcome for the Waltons and Ernest was afforded the honour of preaching at one of their services.

Among the many tributes paid to Walton by his colleagues in Trinity, the congratulatory letter from the late Own Sheehy Skeffington most accurately expressed the feelings of those friends and colleagues who held him in the highest esteem, and ended with a touch of Trinity humour:

> What pleasant reading yesterday's news made! We are all basking, quite undeservedly, but none the less delightedly, in reflected glory. There are very few people of whom one can say that such an honour will leave them quite unchanged. It's quite true of you and to say so constitutes the highest form of praise, in my opinion, though it will embarrass you to have it said.
> I am now resolved as we all are, to go and split something. Unfortunately the linguist is at a disadvantage there, for the only thing he can split with any regularity is an infinitive, and he will get scant credit for doing so!

When asked to comment on the usefulness of his research at the time, Walton remarked:

> 'It gives us knowledge about the universe in which we live. That is satisfying to some but many like more concrete examples.… To prophesy in connection with such matters is rash, but I will hazard a guess. It is that, as happened so often in the past, there will emerge many important uses of which we, with our limited vision, do not even dream.'

This was indeed prophetic when one thinks of the direct spin-off research in CERN and elsewhere. Within the last two weeks, Dr. Oliver Buchmueller of CERN, referring to their investigations into the Origins of the Universe, stated that '2012 promises to be an amazing year for particle physics.'

What I found most revealing in Ernest Walton's papers when I began researching his life and work was the extent to which he pressed the government for more support for teaching and research and identified its importance to the nation's economic prosperity at an early stage. In April 1957 he wrote to the Taoiseach, Éamon de Valera highlighting the overall plight of scientific research in Ireland and its implications for economic growth: 'We in this country are not laying a sufficiently firm scientific foundation on which to build prosperous industries and to increase agricultural output' he argued, 'We are today entering a new scientific era and, if we are to benefit from it, our people should not be allowed to grow up scientifically illiterate.' In an appended memo he further argued against 'taking our industries second-hand from other countries which would expose us to the danger of getting those industries which other countries no longer considered to be profitable'.

This was real foresight at work in predicting the future knowledge economy. It was a truly important initiative when placed in the context of the dramatic transformation that took place in Irish society two years later under Seán Lemass, de Valera's successor, who, along with his senior civil servant Ken Whitaker, set out to establish a strong manufacturing sector based on Foreign Direct Investment. But Walton had gone one step further in underscoring the future role of science in industrial growth and the concomitant need for an indigenous scientific community. In that sense Walton's masterful exposition of the way forward for Ireland some 60 years ago remains a valid template for continued progress in today's knowledge economy.

Unfortunately, De Valera had not shared Walton's concerns with his colleagues, as indicated to me later by Dr. Whitaker who remarked that the letter would have strengthened the case for industrial development at the time.

After his retirement in 1974, Walton continued to come to the Department where visitors, on being introduced to the quiet, unassuming man in the tea room, could barely conceal their astonishment to find that he was one of the great scientists of his time.

In 1983, Freda Walton died and, in time, Ernest returned to Belfast where he had spent his formative teenage years at Methodist College. His last months were in a Belfast nursing home close to his daughter Marion and her family. Even at that late stage in his life, his visitors were rewarded with the stimulating conversations and reflections of a man who was as mentally alert as ever. As one such visitor put it, 'his recollections of those days back in the 1930s still brought an animated smile to his face.' In November 1994 our Chancellor Mary Robinson, then President of Ireland, paid him a visit in his Belfast nursing home to honour him as a man of science and a man of peace.

Ernest Walton had lived at a time of turbulent, almost cataclysmic transition. His native land saw revolution, civil war, and the foundation of a new state. It was in this new state that Walton made his own quiet and unassuming contribution to our national life. His conviction that science must play a significant role in human culture is a major part of his legacy to us. Having attained the summit of his early ambition, this quiet man of humble disposition led a long and contented life in retirement, having inspired several generations of physicists who came after him. His four children, Alan, Marion, Philip, and Jean are all scientists, the first three physicists. The family tradition continues with his grandchildren. Indeed, that inspiration found many outlets in many different ways, one of which was illustrated recently in the Belfast Telegraph of February 25 last: In an interview, with David Lapsley, Minister Emeritus in Belfast's Fisherwick Presbyterian Church, when asked to describe his finest moment of spiritual enlightenment, he responded:

> It came in my student days when I had great misgivings, both about my Christian faith and my calling to the ministry. I heard a lecture given by the Christian nuclear scientist Ernest Walton entitled 'The faith of a scientist'. I still remember the freedom it gave me to believe again.

Shortly before his death in 1995 the family marked his lifelong devotion to Trinity by presenting his Nobel medal and Citation to the College.

He received many awards and distinctions throughout his life and the 100th anniversary of his birth in 2003 was marked in Ireland with a special commemorative postage stamp. President Mary McAleese also hosted his family and friends in Áras an Uachtarain in recognition of his great contribution to Ireland as a pre-eminent scientist, humanitarian and educator. The Physics Department also commissioned a biography of his life entitled 'Ernest Thomas Sinton Walton (1903-1995): the Irish Scientist', the proceeds of which continue to support a student scholarship. The book is available in the Library Shop. Our own in- house poet in the Physics department, Professor Iggy McGovern, penned a moving tribute to him in 1997 entitled *Hammer and Spark*:

Not the mace proclaiming
The glorious news,
Nor the cartoon mallet
Of the first "atom-smashers",
Nor the claw dismantling
The timbers for reuse,
Nor the gavel expounding
The laws of student Physics,
Nor the sledge on ploughshares
For the global village:
Listen! A gentle tapping,
The peen of silversmith,
The scintillations that
Betoken faith.

In this year in which Dublin is the European City of Science, the College will erect a fitting monument as a lasting legacy to Ernest Walton who has contributed so much to the College and to the nation as a whole.

I would like to say in closing that those of us in College who had the good fortune to know Ernest Walton as a colleague and mentor were truly enriched by that blend of wisdom, integrity and foresight, as well as his wry good humour that often surfaced in conversation. I am privileged and honoured today to have the opportunity to share these few reflections with you.