



Michael Atiyah

Ronald Shaw 1929–2016 by Michael Atiyah (1954)

Many famous Trinity scientists have won Nobel Prizes: Ronald Shaw famously did not win the Nobel Prize for Physics. Those in the know thought an injustice had been done, articles were written, speeches were made and his name was retrospectively added to the great Yang-Mills Theory. Ron was bemused and, while enjoying the soft glow of reflected glory, admitted that he preferred the quiet life of not being a celebrity.

He spent his entire academic life after Trinity in Hull, out of the limelight, like the Librarian Phillip Larkin with whom Ron shared a love of Poetry. To outward appearances, Ron was indeed the ultimate self-effacing scholar who enjoyed quiet games like bridge or chess and occasional trips to the seaside.

As mathematical scholars of Trinity in 1949 he and I were in a talented cohort which produced a Lord Chancellor, Heads of Colleges and Fellows of the Royal Society. Ron was an active member of our group, splashing around like a young puppy in this Newtonian pool. He bubbled with new ideas and flashes of insight which, at the time, slightly amused his more sophisticated friends, but in later years were recognized as the acute perceptions of an original mind.

Had God's dice fallen the right way, Ron could easily have had a highly distinguished academic career at Trinity, rising to the highest ranks. His mild eccentricities would have been par for the course and eventually his portrait or his bust would have adorned the Hall or the Library.

But the dice fell differently, and Ron settled in Hull for a much less glorious career. "A brilliant Wrangler" his colleagues would mutter, "but he fizzled out young and was swallowed up by Hull". Many of his more fortunate contemporaries would have regretfully concurred "nice chap Ron, but probably too eccentric, lacking drive and ambition."

We were entirely wrong on all counts as I discovered when researching for this memoir. Hull was not the prison it seemed, it was just his home base.



Ron at his desk Hull 2005.

Professionally he was in demand at small conferences and workshops, particularly those in the Eastern Mediterranean. The Greek Islands, Turkey and Bulgaria attracted him, and his personality blossomed. Exciting adventures in exotic places, dancing with the locals and exploring dangerous mountains became the secret life of the quiet Hull academic. This was not the scandal that ruins political careers, just the antics of an unusual traveller.

Before letting Ron tell his own story through his witty and revealing blog we should hear a measured assessment of Ron's scientific contributions. These are the words of Professor John C. Taylor FRS of

Peterhouse, an exact contemporary of Ron, who was well-placed at the heart of theoretical physics in Cambridge, Oxford and the United States, to see it all. By temperament John is cautious and accurate, unlike many in his field. His words carry added weight and enable him to reach a balanced scientific judgement on Ronald Shaw, despite their close personal friendship. Here is what John wrote

“In the early 1950s, Ron Shaw was a graduate student in the Mathematics Faculty in Cambridge University, and a member of Trinity College. He was researching in mathematical physics. There were then among the staff three men important in Ron's development. There was the great Paul Dirac, one of the founders of quantum theory. And there were Nicholas Kemmer and Abdus Salam (later Nobel Prize winner), the latter being Ron's supervisor. At that time, there existed an almost complete quantum theory of photons and electrons, but there was no fundamental theory of the forces between protons and neutrons in atomic nuclei. There was one clue: protons and neutrons are very similar to each other, except that protons have electric charge and neutrons do not. This suggested some sort of symmetry under the interchange of protons with neutrons (called isospin symmetry), and Kemmer had given a general, mathematical, formulation of this notion.

Ron had the idea to make a theory of “photons” with isospin symmetry. This entailed having three kinds of “photon”, each having a dual role, as a carrier of charge and as the “photon” emitted by the charges of the others. The mathematics was beautiful, but it appeared to have no application in nature: there are no charged “photons”. For this reason, Shaw and Salam decided not to submit the work for publication, although it did eventually form part of Shaw’s doctoral thesis (dated September 1955).

Meanwhile, in America, the physicists C-N. Yang and R.L. Mills, independently, had had exactly the same idea. They, however, were not so self-critical as Shaw, and had published their work in October 1954.

Nature works in a subtle way. In the early 1970s, it emerged that the Yang-Mills-Shaw theory does indeed underlie the nuclear forces, although in a hidden and unexpected way. Not only that, but the theory also, in a different hidden manner, accounts for the weak radioactive decays of nuclear particles. As a final twist, the Yang-Mills-Shaw theory has been used in the 1980s as a tool to prove important new mathematical theorems in geometry.

Ron was a formidable player of games, for example, bridge, chess and “go”.

Here are extracts from Ron’s blog on his Hull website <https://web.archive.org/web/20160223144844/http://www.hull.ac.uk/php/masrs/>



Ron dancing at Rhodes 2003.

The years 1929–1949

As an academic, I could well hold the record for lack of physical movement:

- 1929 Born on 5 September, in Tunstall, Stoke-on-Trent
- 1929–1947 Stoke-on-Trent
- 1947–1949 Derby (National Service)
- 1949–1955 Cambridge University
- 1955–1989 Hull University (assistant lecturer, lecturer, senior lecturer)
- 1989–1995 Hull University (personal chair in Mathematical Physics)
- 1995–2016 Hull University (Emeritus Professor)

When I recount this lack of movement to younger colleagues, who appear to change university, and quite often country, every 2 years, I always hope that they will say something like: “Yes, but you have had some adventurous intellectual voyages”. But they never do!

1947–1949 National service: Assistant in the Royal Army Dental Corps.

I ended up in Derby, at a one-man Dental Centre, which, along with my bedroom, was situated immediately above a morgue. I spent my days making plaster casts of teeth, and squeezing out through muslin – with bare hands! – excess drops mercury from amalgam fillings. I always blame the mercury poison that I must have absorbed for my later difficulties with group cohomology and the like. I shared the experience with Isaac Newton who, as an alchemist, actually tasted the chemicals he worked with. At age 49, he became emotionally disturbed for a couple years. In 1979, hair strands from his corpse were tested for mercury and were found to contain 75 parts per million. (Normal levels are about 5 parts per million.)

Who/what links homology to Carmen Jones?

Well, for me, the answer is Michael Atiyah. One day, while a group of us were strolling after lunch around the Backs, Michael announced that the most important equation in mathematics was $x^2 = 0$. I did not understand this at the time, but, decades later, I dimly appreciated it whilst failing to come to grips with MacLane’s book “Homology”. One evening, a little later, a group of us emerged from the cinema in the Cambridge marketplace after having seen the film Carmen Jones. I myself was completely ignorant of opera and so was not aware that the film was based on Bizet’s Carmen. However Michael pointed out with amusement that Escamillo (the toreador) had been transmuted in the film to Husky Miller (boxer).

P.A.M.Dirac (1902–1984)

On 13 November 1995 a one-day meeting was held at the Royal Society in commemoration of Paul Dirac. Afterwards I joined a large group of people in Westminster Abbey for a Service “Dedication of a Memorial to Paul Adrien Maurice Dirac, OM”. The Memorial plaque was placed adjacent to the grave of Isaac Newton. The service included a series of readings about Dirac. The one description of Dirac that still lingers on in my mind is a quotation from Niels Bohr: “Of all physicists, Dirac has the purest soul”.

Trivial pursuits : Bridge, Fairies and Swinnerton-Dyer

I also developed a keen interest in playing bridge. After dinner when having a few rubbers of bridge in John Brew’s room, Peter Swinnerton-Dyer, at that time a Junior Fellow at Trinity, would quite often drop in on us and pass barbed comments on the standard of our play. (Around that time he did play for England in Helsinki). Now Swinnerton-Dyer was certainly not at all responsible for the time I “wasted” playing bridge away from mathematics, but I do somewhat blame him for introducing me to faery chess and the joys of archbishops (which bounce off the edges of the chessboard in a rather undignified fashion), knightriders (that is $(n,2n)$ leapers) and grasshoppers. Too often I spent hours after midnight trying to decide such things as: can two knightriders force mate against a lone king?

Wolfgang Pauli (1898–1988) is my grandfather

My first research supervisor, Nicholas Kemmer (1911–1998) [footnote: Kemmer, like Shaw, did not get a Nobel Prize, but he was elected an Honorary Fellow of Trinity in 1998], was himself a research student of Wolfgang Pauli (1898–1988). Kemmer told me that, in his first week, Pauli had given him an extremely tough problem to investigate. Kemmer was so dismayed by how difficult the problem was that he very nearly gave up Theoretical Physics completely. So, to protect me from a similar dismay, Kemmer decided not to suggest to me any problems in my first year of research. Instead he guided me through the occasional Pauli paper, and made various suggestions (Schwinger, Feynman, Dyson, ...) of other papers to read. This suited me very well, as I liked to work on my own, following up my own ideas. In the middle of 1953 I was expecting Kemmer to make some definite suggestions, and I am not at all sure that I was going to welcome them. But in fact at this point Kemmer left Cambridge to become Tait Professor of Mathematical Physics in Edinburgh. Eventually, in early 1954, I became a research student of

Abdus Salam (1926–1996). Salam’s tendency was at the other extreme from Kemmer’s: Salam was buzzing with research projects, often involving nuclear physics of which I was woefully ignorant. Consequently I tried to keep away from Salam as much as possible, and to carry on following up my own ideas.

Yang-Mills-Shaw theory

The idea came to me in a flash while reading a manuscript of Schwinger’s, which I found left lying around in the Philosophical Library in Cambridge. I showed my generalization to Salam in early 1954, but in a rather disparaging way, since I did not doubt at that stage that the new nonabelian gauge fields would require particles to have zero mass, and such particles did not appear to exist in nature. Later on in 1954, Salam showed me the paper by Yang and Mills. Salam still wanted me to publish my contribution, but I never did. On many occasions (the 1962 Istanbul Summer School on Group Theory in Physics, the Schrodinger Centenary Conference at Imperial College in 1987, ...) he publicised my independent discovery. In his Nobel Prize Lecture 1979 there are several references to Yang-Mills-Shaw theory. I have also recently come across a letter from Salam to me dated 1 Oct 1988 (in connection with the submission of a paper of mine to Proc. Roy. Soc.) in which he again refers to Yang-Mills-Shaw theory, and reminds me:

“I still remember asking you to publish this and you were very shy at that moment because you thought Yang-Mills had published it already although you had done the work independently.”

However most physicists just refer to Yang-Mills theory – and actually I am quite glad of this! I like a quiet life, and would not have enjoyed being pestered throughout the decades by lots of queries from researchers expecting me to be up to date with latest developments.

Mind, and Bertrand Russell

In 1958 I was gratified to have a paper “The Paradox of the Unexpected Examination” accepted by the philosophical journal *Mind* (see *Mind* 67 (1958) 382–384) – especially as it was next to a paper by Bertrand Russell.

Extract from B. Medlin, *Amer. Phil. Quart.* 1 (1964) 66–72:

“Several philosophers have discussed this problem in *Mind*. Of these, we must put Mr. Shaw first and the rest nowhere.”

Unorthodox route from Hull to the 1962 ICM, Stockholm

In 1962 I decided to drive to the ICM at Stockholm in my Mini car. The resulting distance on my odometer might seem a trifle excessive, since it recorded > 4,000 miles!

This came about because I was in an unusually adventuresome mood and decided to drive to Stockholm via Istanbul. For in that year there was an Istanbul Summer School of Theoretical Physics, which took place in Robert College, Istanbul. I remember picking up two other participants in Strasbourg, and I believe we made it to Istanbul in just over 4 days and 4 nights. I particularly recall an interesting stopover in Skopje (before the devastating later earthquake) and also one the next night in Sofia. In Sofia some Bulgarians came to our rescue while we were attempting to decipher the menu in a restaurant. They turned out to be journalists who delighted in showing us around their printing works. Later that evening we joined up with them again and they brought along with them two highly intelligent literary companions, who were much better versed in English literature than we were. I should perhaps have said “English and Scottish literature”, since one of them, a poet, said he had just been translating into Bulgarian some of Burns’s poetry, and he proceeded to declaim some verses to us.

Some non-mathematical memories of Turkey

Partly because my lecturing duties at METU were light, on many weekends I had trips away from Ankara, visiting archaeological and historical sites, such as one where Hittite reliefs were carved out of the rock. On one long week-end some friends took me on a trip to a small town on the Black Sea. I was amused to discover there that, since I was an Englishman, Turks did not consider me to be a real male. For, on a wet afternoon, I was allowed into the local cinema even though the performance was advertised for females only.

One weekend I remained in Ankara but decided to explore on foot the outskirts/arid countryside beyond Çankaya. At one point there was an apparently peaceful scene, with a calf, along with a small dog, lying down outside a small rundown dwelling. But as I walked away the dog came behind me and bit my Achilles tendon. Consequently I had to start a course of daily anti-rabies injections in my stomach. My Turkish friends managed to get the dog captured and put under observation to see if it had, or developed, rabies. A man, a Maronite Christian from the Lebanon, whose apartment was next to mine, told me that when a similar thing happened to him he went back to collect his family sword and

then returned to sever the dog's head, which he presented to the hospital for rabies tests! (Actually what the Lebanese did was unwise, since the dog needs to be kept alive for some days to see if eventually rabies manifests itself.) By an extremely lucky chance a couple of days later I came across in an open-air stall the Proceedings of a very recent conference on Virology. I stood in the street a long time reading up about rabies, and learned that the stomach injections I was having originated from live viruses which had hopefully been killed by phenol, but that it was common for people to suffer a fever, and even catch rabies, as a result of the injections. I decided that my chance of succumbing to rabies was slight: I had been bitten in a part of my body far from the brain, moreover through clothing – and the dog had still not become rabid. So I decided to stop taking the injections.

On my arrival back in Ankara I went to METU and discovered a message from the secretary. This was scrawled in lurid red and read:

YOU MUST CONTINUE YOUR INJECTIONS OR YOU WILL DIE.

Philip Larkin

In a letter to Professor Nigel Hitchin FRS, also a Larkin devotee, Ron wrote

“I had intended to end with an apt quotation from Philip Larkin, but I have been shocked to discover how little moved he appears to have been by the delights of icosahedral symmetry. Honesty compels me to point out that he appears also to have a lamentable lack of knowledge of Galois fields. In his poem “Counting” he even appears to have difficulty with the smallest field $GF(2)$:

*Thinking in terms of one
is easily done –
One room, one bed, one chair,
One person there,
Makes perfect sense; one set
Of wishes can be met,
One coffin filled.
But counting up to two
Is harder to do;
For one must be denied
Before it's tried.*

I do like the “One coffin filled” – typical gloomily humorous Larkin.

In these brief extracts from his blog Ron has lifted the veil on his unconventional private life, but perhaps I should lift it slightly further. In 1967 he married Marion Shaw, now Professor of English at Loughborough, and they had a daughter Elizabeth Jane Shaw who became an environmental microbiologist. Liz is now at the University of Reading.



Liz on Snake Pass, Peak District, 2006 (photo by Ron).

Ron subsequently married Peak Yuen, but they separated and it was Marion who organized in January 2017 the celebration of Ron's life. I was scheduled to go to Hull for this occasion but family illness intervened. I sent my speech, commenting that Ron's trip to Stockholm via Istanbul had the makings of an Alec Guinness movie, very appropriate since Ron had patronized the Rex Cinema to enjoy the zany Marx Brothers.

While based in Hull and gallivanting round Eastern Europe, Ron remained very fond of Trinity and of his erstwhile Trinity colleagues. Right at the end of his life, while terminally ill, he planned to attend the reception held in the Master's Lodge celebrating the election of John Polkinghorne as an Honorary Fellow. Sadly it was not to be, Ron's luck ran out.

At the age of 60 Ron found his interests moving from theoretical physics to finite geometries. He renounced the grand physical universe for the petty field of design. Too old for the former he found his metier in the latter. As he observed "There is one advantage of switching research fields from Mathematical Physics to Finite Geometry, namely that it is much easier to discover a new

configuration in Finite Geometry than it is to invent a viable new particle in Mathematical Physics!"

In fact the transition came not instantly but by stealth. Ron the physicist gradually metamorphosed into Ron the designer. There were several strands in this process, some from his teaching, some from Clifford (Trinity), 1845–1879, some from his own love of symmetry.

While teaching linear algebra, Ron decided to write his own books, a programme which mushroomed into two large volumes on “Linear Algebra and Group Representations”, which met an enthusiastic response. Gian-Carlo Rota’s review (in toto) read: “Important notice: This is probably the first comprehensive and informative non-doctrinaire presentation of multilinear algebra ever written.” Clifford algebras play an important role in physics and Ron understood both the physics (through his own research) and the algebra (through his teaching). Again he wrote a definitive account of the subject.

Symmetry in all its forms is at the heart of much of mathematics and physics as Ron knew well. So, when he turned his attention to finite symmetries and finite geometries, he was not straying far afield. His comment that abstract algebra is easier than physics, because particles are “out there” and not invented, has become increasingly debatable. Modern physics tends to produce particles of many types and abstract algebra has difficulty keeping pace.

Ron spent the last decades of his life on finite geometries and designs, mainly with his last student Neil Gordon (now Head of Computer Science at Hull). The digital revolution based on the 2 symbols (0,1) and the algebra of George Boole made binary codes supreme. The fact that Dirac’s spinors, with their up/down dichotomy, are fundamental in theoretical physics links the young Ron with his elder self. Somehow, guided by his gut instinct, Ron made the right move when the time came.

Viewed from the perspective of history Ron, the “odd-ball”, will finally be appreciated.