Reflections of a Natural Philosopher – John S. Reid

I've spent years of my career, off and on, ferreting out the details of the lives of those who have passed away. It takes time. Should anyone in the future wish to look at who John S. Reid was, member of the University of Aberdeen for over 11% of its 524 years of existence as I pen this, then the following may save them some trouble. Some of the story is intended to illustrate who he thinks he is, some his experience at the University, particularly in the Department of Natural Philosophy, and some describe what he has done with his time there. There is a sprinkling of personal opinions among the history.

I was born on 9th May 1942 in Chorleywood, then a small town near the edge of the London commuter belt serviced by the Metropolitan line. My father had married in 1940, aged 46, having had a career dictated by the times. He was called up at the age of 21 at the outbreak of WWI and survived in the fields and trenches of Belgium and France, against the odds. Having trained as a business accountant, escaping unemployment in the UK he spent much of the 20s and 30s abroad in Europe, South America and even Australia. My mother was a secretary until she married. I mention this because we not only inherit the genes of our parents but through nature and nurture our characters, too, reflect their influence.

The first months of my life were not the happiest for my parents or me, since I had great difficulty in keeping food down. The cause, it was diagnosed, was pyloric stenosis. Intervention surgery was performed at London's Great Ormond Street Hospital in December 1942, not the best of times and places to be ill. It has often occurred to me since that without 20th century medical knowledge and skill I would not have had a life to live.

I grew up in a house where the bookcases included works in French, German and Italian with a few in Spanish and, later, some in Gaelic and Russian. On a good day my parents could solve The Times crossword puzzle in 20 minutes, without the aid of any University education. The piano, bagpipes or practice chanter were played on almost a daily basis. My father could turn his hand to practical repairs and before we moved to Aberdeen he had a nice carpenters' wood bench, with vice and tools in the garage. I suspect it was this that got me keen on making things. There was, though, no interest in science in the house.

The first house I lived in until about the age of 8 had its garden adjacent to a wood. We had beehives in the garden, a good move given that sugar rationing continued into the 1950s; there was a piggery at the end of the road to where we took food waste, and fields close by. Recycling was so much part of life it didn't have a name. We were on the edge of the small town and given the freedom to roam that there was in the 1940s I spent a lot of time in the countryside. My lifelong interests in meteorology and astronomy, that would serve me well in academia many decades later, probably have their roots in the dark nights of the 1940s and my love, like that of Luke Howard, of watching clouds. Had you asked me before the age of

10 what I might be when I grew up, I would probably have said 'a naturalist'. By then, though, life had taken a turn for the worse.

Aged 7 and 8 I had got into substantial trouble at school. I disliked the teachers with their seemingly arbitrary and unfair exercise of authority. They didn't seem to like me. There wasn't an alternative school within travelling distance (we had no car then, just my father's motorbike and sidecar) and, aged 9, I was dispatched by Flying Scotsman to the boarding house of Robert Gordon's College, Aberdeen, some 500 miles distant. One could send youngsters off by themselves on long journeys in those days. My grandfather and his ancestors had been born on Aberdeenshire crofts and there were four families of cousins in Aberdeen and the suburbs who could keep an eye on me at weekends and provide some break from institutional life. 1951 saw me arrive in Aberdeen and I'm penning this 68 years later, still in the vicinity.

By 11, though, I was showing traits I would use as an adult. I had built not only crystal sets but a 2-valve radio at home. In the boarding school, by 12 I would listen under the blankets at night to the crystal set reception, using the bedsprings as an aerial. It was important, though, not to be caught doing this. I collected things: butterflies (unthinkable these days), stamps, foreign and UK coins (I'd accumulated a pound's worth of farthings (960) and coins going back to George III, still in circulation), cigarette cards (obtained from adults but circulated by kids). I dabbled in photography, developing my own negatives and contact printing some pictures in the sunshine. Once in secondary school, there was an attic room that we boys could use in the boarding house for making things. Model planes were the favourite. Balsa wood kits were bought with saved-up pocket money, the pieces carefully cut with an Xacto knife, the frameworks assembled, glued and covered with tissue paper that was finally coated in 'clear dope', a varnish that set hard. The planes flew quite well. The more advanced planes included a 1 cc diesel engine and control strings that allowed the plane to be flown in circles.

At school I came near the top of my classes in Maths, Science and Geography and near the bottom in everything else. I had clearly been bitten badly by the science bug. If my interest in maths and science had any genetic origin, then it likely came from my mother's side of the family. One Art teacher gave up on me and let me make models at the back of the class. This was, perhaps, youthful immaturity on my part for later as a student I would subscribe to a history-of-art magazine and as an adult I would enjoy making screen prints and pottery. At school, I joined a few others in the music class who weren't even selected for the 'big choir' and we added a half-hearted dirge at the back that we hoped wouldn't be heard and we suspect the teacher hoped he wouldn't hear. Classes were 40 strong during my time at school in both primary and secondary and the impression I got was that the teachers saw their job as drilling the pupils. Little effort seemed to be made by most teachers to help those who found subjects difficult. They were more likely to receive sarcastic comments along with their poor marks, be told they were useless and end up ignored at the back of the class. *"Ogg, did your mother do this homework?*" "*No, sir*". "*Pity, she'd have made a better job of it*". [That was in the Latin class]. It seemed to me that only those who were pretty good all round had much good to say about the school. I believe things have changed, in many respects.

I'd spent 6 years in the boarding house before being released at the end of 3rd year, when my father retired from his London job and the daily commute into the city, to move to Aberdeen.

I had tried to keep my head below the parapet but didn't always succeed. "*Why is your coat still on, Reid?*". "*Because I haven't taken it off, sir*". "*Enough of your insubordination*". Er, what was wrong with that reply, I thought? I suspect I was tolerated because I was one of the very few boarders who were in the A class when I left.

By the start of 4th year my parents hadn't yet moved to Aberdeen so, aged 15, I was put up with a landlady in Forbesfield Road for some months. I'd lived with rules at school and rules after school. My only memory of that period is enjoying the freedom to call a lot more time my own. Our family (parents and younger sister) moved into the last house in Hamilton Place (no. 156), built on the ground that once supported a house where Byron had lived, according to local history. His vibes didn't help me with Higher English, though I managed to pass without them. I did get an attic room in the house to freely pursue my interests in radio. Radio was the means of instant general communication of the day[1]. Money being short, everything had to be built or salvaged from war surplus material, advertised copiously in radio magazines but available more cheaply at the 'junk sales' of the Aberdeen Amateur Radio Society, where I was a very regular attender. By 17, I had my full amateur radio transmitting licence, having sat exams in electronics, the international amateur transmitting regulations, and Morse code at the Stonehaven Coastguard Station. I still have the licence. GM3NUU is the callsign, but it hasn't been heard on the air for decades. In fact it was never heard that much because most of my communication was done in Morse on the 80 m and 40 m bands. My 'long wire' antenna with a ladder feeder made with spacers cut from garden bamboo sticks and covered with candlewax to keep out the weather, stretched down the garden to a pole at the far end. My homemade transmitter would regularly reach across Europe and once, thanks to freak conditions, to New Zealand. Visitors to my den were greeted with a motto over the door '*no se conoce el bien hasta que se ha perdido'*, which came from the wisdom of Don Quixote. Somewhere inside me even then was lurking the Honorary Curator of a scientific instrument collection, a responsibility I would have 40 years later.

One lesson I learned at the Amateur Radio Society has continued to humble me. A good many of the members had little formal knowledge of electronics yet they could work the equipment, knew what components did, not just in generality but precisely, they could repair equipment that didn't work, and more. Never underestimate the amateur. I've found the same is true in other areas too. Formal qualifications can be over-rated.

At home I was able to convert the built-in wardrobe in my bedroom into a darkroom when needed, to develop film in open trays and make enlargements on a home-made enlarger. School success and lack of it continued much as before, which created a bit of a cloud on the horizon for I wanted to go to University. Latin had been dropped as an entrance requirement while I progressed through the school so getting a Higher in that was no longer important. When my concentration in the subject waned even further, I was told "*Reid, you can go through to the bad eggs*", namely the next-door Lower Latin class. That was something of a relief. I passed Lower Latin among my modest 5th year results but I sat the University's open Bursary Competition, came in the top 6 and was immediately offered entry. I didn't go to

[1] My parents didn't have a TV while I was at school. When they did get one in the early 60's it was a small 'box', monochrome, 405-line picture with a choice of 2 channels. My father secured a retirement job at Grampian TV when it opened in 1961 but we could not afford a colour TV even when we married in 1970.

University at the end of my 5th year at school but stayed on for a 6th year, taking three advanced maths subjects, an optional advanced physics class and Higher Geography. It was the only year I enjoyed at school. I still remember one incident when myself and my good friend Sandy Watt tried to slip into a double period physics class unnoticed a few minutes late. We were noticed and the physics teacher 'exploded'. When his rant had died down we said '*we're not supposed to be here but we've come out of interest*'. He visibly shrank behind his bench with apologies. No-one in his decades of teaching had ever voluntarily come to his class.

In the 6th year we were treated as people and the headmaster allowed myself and a few others to play golf on Wednesday afternoons at Hazlehead instead of participating in the compulsory sporting activities of rugby in the winter and cricket or athletics in the summer. I had, once, played rugby for Gordons College against their old rival The Aberdeen Grammar School but my heart was never in it. They must have been desperate to include me. The Headmaster (Mr Collier) did no teaching, understandable in a school with some 1000 pupils. Being invited into his office was a treat normally reserved for near delinquent behaviour. My only visit was in my 6th year when, it turned out, he was 'interviewing' pupils about their future careers. "*Well, Reid, have you any idea what you want to be? It certainly won't be a teacher.*" He had at least clocked that I was a boy with a stammer. Having ascertained I was going to University, that was the end of my career advice. I've done a lot of teaching since then.

University in 1960 was like a breath of fresh air after school. No-one sneered at you for working hard or being well endowed with curiosity. One of my father's elderly cousins (retired procurator fiscal for Aberdeen, Gavin Sinclair) had died and left me £150, enough to buy a second-hand car. I'd passed my driving test in 1959. The car was a small, black Austin 8, a product of the mid 1940s – completely utilitarian but with leather seats and very reliable. If the battery didn't start it, the starting handle would. Like much of the technology of the day, it was full of user-serviceable parts and in any case the MOT test certificate didn't exist. The car made a significant difference to my university social life. I was invited to parties I wouldn't have gone to, for I was 'transport' and there were no significant drink driving rules. If truth had been told, it was probably on account of my car that I was a member of the University golf team on quite a few occasions, for my results on the course barely merited it. I even played chess for the University during the brief existence of the University Chess Club, but my memories of that are that we travelled to events by train. Any idea that I was much good at chess were eclipsed by watching the team captain play simultaneous blind games on the train with no board (and winning).

The BSc regulations at the time (1960) were that every BSc student had to take at least one of the subjects of Nat Phil, Maths or Chemistry. This applied to intending Botanists, Geologists, Psychologists and so on. There were 4 first-year Nat Phil classes – one for those intending to progress in the subject or related subjects, a service course for other BSc students, a course mainly for Foresters and Agri students and a course for Medics. My first-year choices were Nat Phil and Maths (compulsory for an intending Hons physicist), Chemistry and Geology. Maths seemed easy after the 6th form 'advanced maths' and I blotted my University record by obtaining only a second-class certificate through underestimating the standard expected – a lesson for future years. In the summer vacation I received a letter from Professor Burnett, Head of Chemistry, offering me a Robbie

Scholarship if I took second year chemistry. I remember being outraged – this was a bribe and I would have nothing to do with bribes, there was now no way I would take chemistry. I probably wasn't going to in any case. We had had memorably poor lectures in organic chemistry in the large Meston 1 lecture theatre. The professor (not even just a lecturer; I'll spare you his name, though he's almost certainly long since passed away) would stand facing the blackboard, look down at his shoes and speak in a mumble while writing up reactions with the chalk. Geology won hands-down in making a subject attractive. There were 6 outings to cliffs, quarries, rock faces and of course either side of the Highland Boundary Fault. We each had to purchase a geological hammer and many came back with samples – not really a sustainable method of teaching but cliffs and quarries are big. The bus trip home was always an excuse for rowdy and bawdy songs. The geology practicals every week, overseen by the very able Frank Tocher, were well illustrated by example rocks and crystals. I didn't take Geology in second year but I've kept an interest in the subject all my life so one can hardly ask for more inspiration from a lecture course.

Second year 'Intermediate Honours' in Maths and Physics was a lot of work. I realised later that, deliberately or otherwise, it was quite a fine academic filter. Only those who were pretty competent at Natural Philosophy passed. The net result was that Honours Natural Philosophy had small classes but over the years there were few 3rd class Honours awarded. The policy almost certainly discriminated against 'late developers' so the subject lost some students who might have done well in the end. We were 12 in my Honours year. Four of us formed a particularly close group, discussing the coursework and related issues outside the classroom and at times coming to my den to make our own experiments. I've repeated memories of laughing a lot during that time, more than ever since. Physics did seem fun.

Between 2nd and 3rd year I had a holiday job at AERE Harwell in Oxfordshire, acting as assistant in a group that was developing X-ray fluorescence microscopy. Harwell had been founded immediately after the war in 1945 as a nuclear research centre. I had a site access pass, obtained after signing the Official Secrets Act (*I will not follow in the footsteps of Klaus Fuchs ...* . They had nothing to worry about. I'd no interest in participating in politics). There seemed to be few restrictions on visiting the reactors that were in the complex. I vaguely remember the very first reactors GLEEP and BEPO, surrounded by piles of graphite blocks, but more vividly I remember the experience of visiting LIDO, the swimming pool reactor. There was a gangplank over the top of the pool and one could look down from above the pool through only a few metres of water and see the whole pile glowing blue with Cherenkov radiation. I've always had a strong streak for 'reality checks', seeing for myself what is presented in words and images. Here was the reality check on the explanation that faster than light particles would radiate – faster than light in water but not in vacuum.

Another memorable experience was visiting the fusion test reactor ZETA at nearby Culham Laboratory. Creating energy by fusion had been one of the visions of G P Thomson, Aberdeen's own Nobel Prize winning physicist. The heart of ZETA was a torus containing hydrogen isotope plasma. The torus was strapped in cables almost as thick as my wrist to carry the huge current used to generate the plasma confining magnetic field. The current was created by discharging an enormous bank of capacitors stacked floor to ceiling it seemed in a separate room, which we were shown. We saw ZETA in operation. The magnetic forces on the cables when the current pulse flowed caused them to spring off the torus and snap back with an explosive crack. Was this the basis of the reactor of the future? Well, it might be but

50 years on the added broad-brush clarity is that it's not going to be that simple, though it certainly didn't look simple at the time.

Between 3rd and 4th year, I had a holiday job with the computing company ICT in Stevenage who were seeking better alloys to be used as thin film storage media. My job was to mix assorted ingredients, sputter the samples in vacuum to create the films and, I think, measure their hysteresis curves. There must have been some analysis too, because I remember the films didn't have the same composition as the starting ingredients, due to the different evaporation temperatures of these ingredients. During that summer, the Department moved from Marischal College to the new Natural Philosophy Building at King's College, opened by G P Thomson himself. We were the first Senior Honours class to have lectures there and use the spacious new labs. The teaching regime was pretty different to that in place today. The class was divided into tutorial groups of 3 or 4, with each group assigned a different tutor. We met the tutor once a week to go over homework in the assorted subjects and hopefully clarify our difficulties. There were no student posters or presentations, no group work, no long projects, no continuous assessment. Yes, we had 9 hours of practical classes a week during the whole of the third and fourth years. The experiments generally had some open-ended content. Each experiment was meticulously marked on an α, β, γ scale with + or – at each level. All these marks counted for nothing towards our Honours grade. This was determined by 2-days of practical examinations (one in electronics, one in any other area) and 5 written papers. The only exams during the two Honours years were at the end of the final year – 'The Finals' – stretching over not much more than a week at the end of May into early June. I had played a lot of golf in my Honours years in a foursome we'd started at school, a lot of snooker in my fourth year and spent a lot of time on amateur radio during third year, before we moved house to Cults in my final year. The way to redeem oneself was by 'swotting' for several months before the finals. That was the system and, notwithstanding the many hours spent talking about Physics outside lectures and tutorials, we played the system, as many others had done before. The plan teetered a bit in mid-May 1964 when Aberdeen was struck by a typhoid outbreak and became almost a quarantined city. There was talk of postponing the degree exams. Fortunately for the plan, that didn't happen. I had no idea at the time that my future wife, Aenea, would be one of those who spent several weeks in hospital with the illness. Half the class in my year ended up with first-class Honours degrees, a feat that I don't think has been replicated in Nat Phil and which I attribute to the mutual support we gave each other.

Having been capped one morning in early July (1964) I set off that afternoon to hitch-hike to Madrid where Don, one of our golfing foursome, was spending some of his time of study abroad. Having reached the border at the South of France I found out that hitch-hiking was illegal in Franco's Spain. Poor homework beforehand to just discover this then. Some people did it, but I decided to buy a 3rd class train ticket to Madrid. It was a slow, perspiringly hot journey made with inadequate water in what seemed like a cattle wagon with added wooden seats. It is still seared in my brain as one of life's uncomfortable experiences. Madrid, though, was memorable. Don turned out to be sharing a flat with a student of the guitar. He took me to the workshop of Alfonso Checa, one of Spain's notable makers, and under his guidance I bought the best classical guitar I could afford. Hitch-hiking back through France and the UK, some lifts wanted to be serenaded but learning to play was a project for later.

I do remember spending some time in 4th year wondering where to go afterwards – industry or academia? Industry, for me, would be about technology; academia about understanding. In early October, thanks to a Carnegie Scholarship I enrolled as a PhD student of Tom Smith to work with diffuse X-ray scattering. I didn't know much about the project but it was about trying to understand how atoms in a solid moved, how their movements determined solid state properties and whether diffuse X-ray scattering could be used to pin down detail of that motion. It turned out to be a minority interest in the much larger area of X-ray crystallography. 'Understanding nature' was why I wanted to become a natural philosopher. Later I would read that Maxwell as a very young boy would pester his father with the words '*what's the go of it?*'. Exactly. That's what I wanted to know, too.

My project started with designing and building bespoke apparatus to measure the scattering. A lead coat hung behind the door, intended to be worn as protection from stray X-rays. I decided that my design, however it turned out, should not need the use of the lead coat, for X-ray beams of any significance should be contained within the apparatus. The very fine mechanical workshop that R V Jones had built up were able to construct all the mechanical parts needed that supplemented a GEC goniometer base. Jim Thom was the technician mainly involved with me. When I went into the workshop, I quite often heard someone whistling at his desk. That was likely to be Jim Thom. People don't seem to whistle at work these days. G P Thomson famously credited his chief technician as co-author on his Nobel Prize winning paper. Jim Thom didn't get that credit from me but the standard procedure was not to hand in a technical drawing to the Head of Workshop but to go straight to the technician and talk over the issue with him. He would come to the lab and together we decided on final dimensions, materials, critical parts, tolerances, assembly details and so on. The technician's experience in construction and his knowledge of the capability of the workshop machines was far greater than that of most academic researchers. I remember on one occasion needing a spindle to fit the goniometer that GEC had specified should have dimensions to a tolerance of 0.2 thou (5 microns). With some trepidation I went to the workshop and spoke with Henry Barber, who worked next to Jim Thom. "*We've better pieces in the waste bin*" he said, so 0.2 thou did not faze him. That said, it still needed great care and must have been close to the limit of what could be done with the machines.

Jim Thom is the central figure in the main workshop, ~1979

During my first summer as a PhD student, Charles McCombie, Tom Smith, Ray Stevenson and the rest of a small committee organised a summer school in physics at Aberdeen on the topic of *Phonons in Perfect Lattices and Lattices with Point Imperfections*. They assembled

a 'stellar' list of lecturers that included Charles Kittel, whose excellent solid state textbooks were the best to be had, Bill Cochran FRS, leading light in X-ray diffraction and lattice dynamics, Bertie Brockhouse, future Nobel Prize winner for his work in inelastic neutron scattering, Roger Cowley, leading theorist in lattice dynamics and later Head of the Clarendon Laboratory, Roger Elliott from Oxford, Maurice Pryce, by then in LA, and others of equal merit. Some of the School lectures were above the heads of us new students but as locals in the Department we could sit in; we learnt a lot and made acquaintances with rôle models that would last for many years. I think it was at this event that Rudolf Mössbauer flew in, gave a guest lecture and flew out again. Not quite in the spirit of a summer school but at the time he was 'hot'. No-one could accuse Aberdeen of being off the map in Natural Philosophy.

There was a good camaraderie between the research students. Somewhere between half-a-dozen and ten of us used to work most evenings of the week in the department. I remember Tom Smith came in unusually about 8 O'clock one evening while we were chatting over coffee. He had the cheek to berate us for not being at work and to this day I don't know if he was serious or not. He seemed to be. I'd be astonished to find that number of staff or students in the department in the evening these days.

My own experimental work did not go as quickly as hoped for. There were technical difficulties with the experiment and I became diverted with computer programming. By the end of 1964 I had written my first program (in Algol 60) to calculate the X-ray scattering produced by 1-phonon scattering in our material of choice, sodium chloride. The university computer[2] was an Elliott 803 with 8K of storage. By today's standards this was microscopic but compared with the Facit hand calculator on my desk, it was gigantic. Anyone who wanted to calculate phonon scattering calculated the 1-phonon scattering first. If they were keen, then the 2-phonon scattering and the ultra-keen progressed to the 3-phonon scattering.

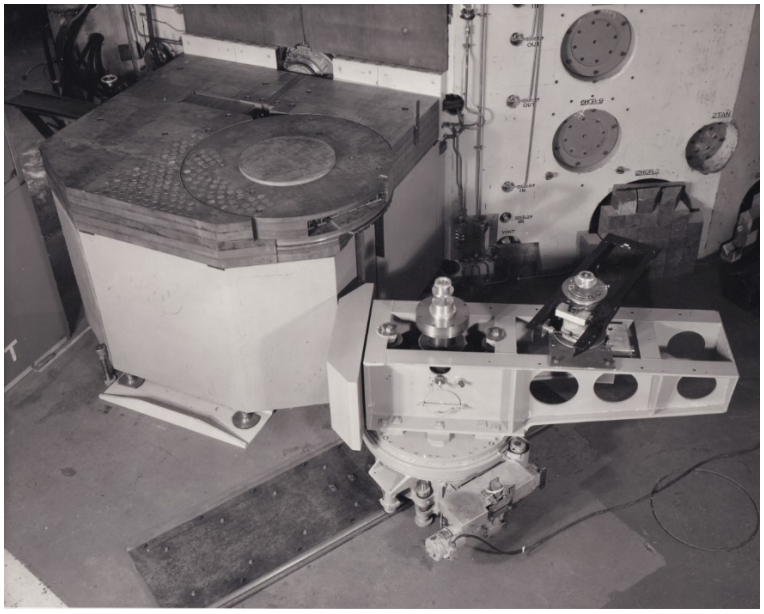
One of my PhD achievements of which I'm the most pleased was to show how one can calculate the total phonon scattering from all processes, dispensing with the need to split the problem into an increasingly cumbersome series. The method and its results were published in the Journal of Physics. In truth it's not had many citations but I believe the method has not been superseded in the following half-century.

Building things in my youth had undoubtedly sowed the seeds of my interest in designing apparatus. In X-ray instrumentation, my converging Soller slits, tracking monochromator and alignment tool that were built in the workshop gave me a lot of satisfaction. I think it was design that wooed me towards computer programming. To design an algorithm, code it, debug it and run it successfully gave me the satisfaction of the designer, of the builder and of achieving a result that was previously inaccessible. Three for the price of one. That was hard to beat.

Another change of tack was the opportunity to conduct neutron scattering experiments at Harwell to find the phonon dispersion relations of sodium bromide. The alkali halides were then the 'go to' range of materials being studied in solid state physics. This took me back down to Oxfordshire on a good many occasions, at first in the trusty Austin 8 before I finally

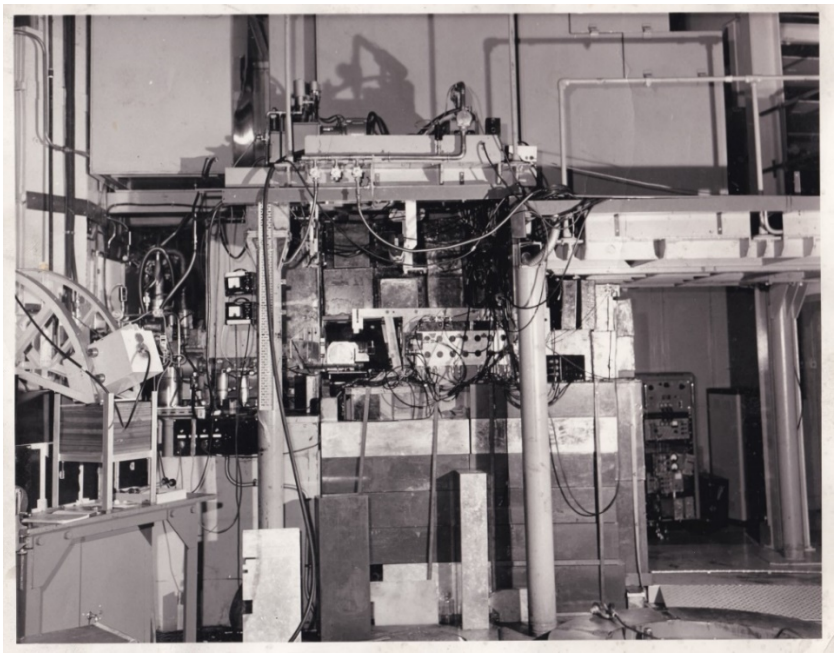
[2] I have written about this elsewhere. At the time of writing this note the URL is https://homepages.abdn.ac.uk/npmuseum/article/Atlas.pdf.

gave it up for an equally black car at the other end of the spectrum, a Jaguar XK140, winner of the Le Mons 24-hour race for 3 years in the 1950s. The long haul to Harwell became a much quicker haul.



The triple axis spectrometer in the 1960s ready for users to mount their equipment: courtesy AERE Harwell

All the neutron scattering experiments were made on apparatus around the PLUTO reactor. The entire building was contained in a pressure controlled cylindrical shell, deliberately kept below atmospheric pressure so that any radioactive leakage would not escape into the surroundings. Entrance was via an air lock. The first measurements were made using a triple-axis spectrometer that had been assembled, I believe, on a surplus gun turret by Stuart Pawley of Edinburgh University. My sodium bromide sample, some 5 cm long by half that in diameter, was grown in-house in Aberdeen by 'Dai' Jones (David Arthern Jones). It was highly deliquescent and had to be sealed in an aluminium can. It also absorbed neutrons quite well, requiring detailed calculations of its effective shape as seen by neutrons. This called for an 803 program in Autocode, with the core routines in machine code, programming at the bottom level.



The Harwell time-of-flight apparatus as used in 1969; courtesy AERE Harwell

The spectrometer results were followed up by slow-neutron, time-of-flight measurements made using the large, nearby apparatus. I've always been astonished by this piece of equipment. In order to produce neutrons of comparable wavelength to interatomic spacings, the neutrons must have an energy of only a few tens of degrees Kelvin. This was achieved by placing a flask of liquid hydrogen within the

reactor, so that the flux of neutrons emerging was moderated to that temperature. It sounds like a recipe for disaster but it worked. The slow neutron beam (i.e. cold neutrons) was 'chopped' into pulses by a very fast spinning rotor with a horizontal path through it divided with Soller slits. The story went that when the machine was being built, no-one could be found to build a rotor that would spin perfectly balanced at the required high speed. Eventually the Rover car company took on the job and produced the required piece. Cars were built then by skilled engineers, not robots. 24 neutron detectors arranged on a vertical circular arc collected scattering simultaneously, timing the neutrons from the spinning rotor. That produced a lot of raw data which required extensive computing to extract the desired information. It was here I cut my teeth on Fortran. I must have spent a good six months at Harwell all told, staying in their hostel and sharing an office with two Cambridge University research students. Analysis also required extensive computer modelling, partly done in Aberdeen and partly by Bill Buyers, one of my initial PhD mentors who moved to Chalk River in Canada. The resulting paper in the Physical Review is still quoted.

I've no intention of going through my career in fine detail. The die was cast. I was a graduate who stayed behind. On the positive side, a psychologist might see a stable character with strong emotional attachments to the area who would go out of his way to contribute to his employer. That's probably right enough. For the record, in 1968 I was appointed Assistant Lecturer in Natural Philosophy and began lecturing to the first-year on Optics and Sound, at least. I remember the Sound lectures in particular because it was a good subject for demonstrations and some time in the 70s the subject fell out of the syllabus, never to come back. I continued taking first-year labs and tutorials, as I had done as a research student. This turned out to have an unanticipated side effect. I met Aenea in the first-year labs of the 67/68 session. We married in the summer of 1970 after her 3rd year in Honours Mathematics, by which time I had secured a lectureship in 'Experimental Philosophy'. She was no-longer my student but lecturers having any relationship with students is now considered completely unacceptable. It was not so in the 60s, fortunately for us. She graduated with first-class Honours and next year will see our 50th wedding anniversary, all being well. Sailing had now replaced golf as my outdoor pastime thanks to Aenea, and we spent a good few years with the university sailing club, racing in the Loch of Skene and in Stonehaven Bay. All of this reminded me of the family rowing, sailing and picnicking we used to do on the Thames in my father's small wooden boat almost two decades earlier. Racing was notionally more serious, though we never had a reputation to defend. Aenea had a *420* sailing dinghy and later we bought a sleek Fireball that we christened *Emmy Noether*, lovingly re-varnished every year. That still didn't bring us any trophies. By 1974, dinghy racing had given way to cruising on the West Coast of Scotland, in a boat we still have.

From 1970 I demonstrated in the third-year laboratories and in the mid 70s gave a course on 'waves' to second year students, in addition to continuing with optics. The waves course was also fun and lent itself to numerous demonstrations and an introduction to students of Fourier series and integrals. The early 70s also saw the introduction of a 3rd year, non-Honours programme called 'Physics III', from which graduates could leave with a BSc and enter the job market a year earlier with a substantial portfolio of physics courses. The emphasis in the third year was on applied physics. This was coordinated by Ian Robertson at first and later by myself. It attracted a comparable number of students to the Honours option. For some 10 years at least, the lectures for these students were separate from the third year Honours

lectures but they gradually merged so that in the end Physics III students took the Junior Honours course and then graduated with a BSc. There were fewer taking the course by then.

In 1973 I passed my Board of Trade Yachtmasters (Ocean) qualification. This involved exams in seamanship, navigation, meteorology, Aldis lamp Morse code and semaphore. I must admit that I've never used the semaphore and the only time I was sent a message by Aldis lamp several years later it was too quick for my unpractised brain. However, the meteorology and navigation have proved very good background for when I received the Honorary post of 'Cruickshank Lecturer in Astronomy, Meteorology and Navigation'. I suspect that few of my predecessors in this post ever lectured on navigation. It was good to not only use my knowledge for personal sailing but to spread it more widely.

Today's lecturers tend to get pigeon-holed. The formalities associated with a course are substantially greater than they used to be. Being asked to give a new course is now a major undertaking. Lecturers are reluctant to volunteer and loath to give up all the effort they have put in to preparing typed and digital media for the courses they now give. I see myself as being exceptional in today's scenario for having given lecture courses in Astronomy, Case Studies, Computing, Cosmology, Crystallography, Data Analysis, Electronics, IT Skills, Mechanics, Meteorology, Properties of Matter, Special Relativity, Sound, Space Science, Statistical Physics, Surface Physics, Synchrotron Radiation, Thermodynamics, and Waves. It's amazing what can be done over 40 years! I've had the pleasure of taking and organizing laboratory classes in all 4 years and running Honours projects. In fact, looking back, it was myself who introduced Honours projects in the late 1980s. It's made for a varied career. I think the modern lecturer may be missing out on the diversity of Physics. I've had the freedom to devise all my courses from scratch and amend the lab syllabus as I saw fit.

Returning to the timeline, the 70s saw my solid-state interests focusing on computational contributions[3], some in collaboration with John Pirie. The mid-70s saw my first articles on pedagogy (particularly in *Physics Education*) and on public outreach subjects (in *The Scots Magazine*). 1977 saw me taking a 3-month sabbatical in Gdańsk. The University had signed an agreement with its counterpart in Gdańsk to exchange academics. The opportunity was like gold for the Gdańsk staff, at that time behind the iron curtain with very restricted opportunities for travel abroad. It seemed that no-one wanted to go in the opposite direction. For me it turned into a brilliant opportunity to see first-hand what Eastern Europe was like. I made friends with the only other passenger who was travelling with me on the cargo boat to Gdynia port. He worked in the shipyards. Later, when Aenea joined me during the summer holiday he organised a trip for us by train to Krakow, Zakopane and the Polish Tatras. Our journey with him and his wife made a large loop through Poland to the very south, stopping at a few towns. Before then, I had visited the home of Copernicus in Torun and had been on several occasions to the Kaszubian lake district where some of the staff had summer houses. Marek Żukowski was my guide during my stay, then working for his PhD and now a Professor there whose research has been recognised by the Prize of the Foundation for Polish Science, the highest Polish science honour. Change was in the air, not least because of the influence of Lech Wałęsa and the rising unrest at the Gdańsk shipyards. It wasn't clear whether the change would be peaceful or otherwise. It takes far-sighted and selfless people

[3] I have written up some reminiscences of the computational work, currently at https://homepages.abdn.ac.uk/npmuseum/article/Atlas.pdf.

to give up power. During my time in Gdańsk I had intended to draft a monograph on optics based on my lecture course but only two or three chapters got written and enough time to finish it never seemed to appear. The experience, though, was exceptional and 40 years on I still keep in touch with some friends made then. I returned to Warsaw and Gdańsk for a month the following year.

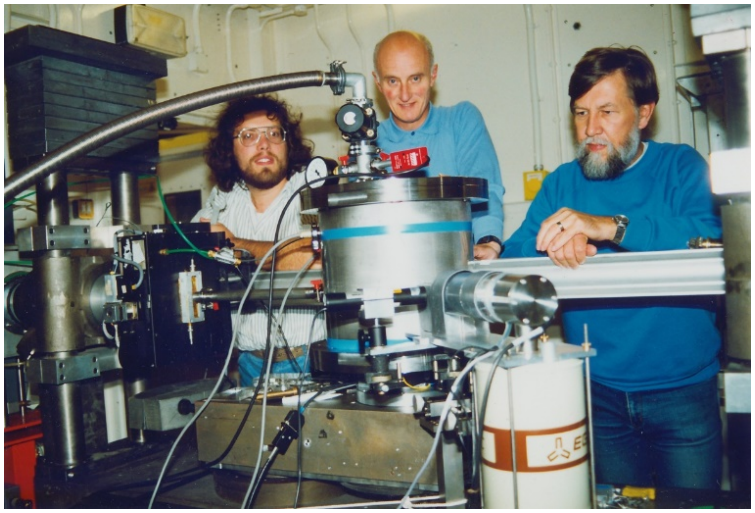
RV Jones retired in 1981. As an undergraduate I had received lectures from him and afterwards seen his style of management for over 15 years. As a lecturer he was strong on anecdote and he loved demonstrations. The Physics was best consolidated from a textbook. He was less successful as a Head of Department. In retrospect, Jones was a brilliant 'backroom boy'. He had a passion for getting the fine detail right and being well informed on the context of the circumstances. These skills had served his country well in WWII. As a long-standing Head of Department, he lacked empathy with many of his staff. I can't remember him once visiting the X-ray lab where I worked. He berated Tom Smith and other staff for not taking an active part in 'his' crystal growing, while not showing noticeable curiosity about their work. From 1961 he had a long-running disagreement with senior University staff on the wisdom of University expansion. Symptomatic of the increasing distance between himself and his own staff, particularly in the 70s, was a challenge by Michael Gadsden in 1979 as to why there had been no promotions for almost a decade and a half and why we had no regular minuted staff meetings where decisions were taken. We did afterwards get two promotions but still no regular staff meetings. By then, the majority of staff felt that his retirement could not come quickly enough. This, at least, was my take on circumstances.

In 1981 Geoff Marr was appointed in Jones' place[4]. The early 80s saw the introduction of articles by me on the history of physics and related subjects. Having heard of steps to form a Scientific Instrument Society in 1983, I joined as one of their founder members and have contributed to their publication and meetings ever since. In that year I wrote up extensive historical work on Patrick Copland for an M.Litt. thesis that the binders accidentally labelled as a Ph.D., so fat was it. They had to re-bind all the copies. I rather enjoyed the irony that having been near the bottom of my class in English at school, the University had awarded me a 'Master of Letters' degree. Their criterion was somewhat different from the school's. Copland sparked an interest in the history of scientific instruments that has still not waned. In 1986 I represented the university's historical instruments on the Museums and Galleries Committee and in 1993 I was appointed by the Court as Curator of the university's historical instrument collection – the Natural Philosophy Collection. This collection has since acquired items from Geology, Engineering, Psychology, Natural History and Computing but Natural Philosophy remains the main focus.

Beginning in 1983, John Pirie and myself developed apparatus for energy dispersive diffuse X-ray scattering at the Daresbury Synchrotron Source in Cheshire. This work[5] got into its stride by the end of the 1980s with PhD student Gordon Milne and into the 1990s with the addition of Moreton Moore from Royal Holloway College, post doc Stephen Clackson and

[4] A labelled departmental photograph (from which I'm absent) taken in May 1981 can be seen currently at https://homepages.abdn.ac.uk/j.s.reid/pages/Profs/Dept1981.shtml.
[5] Further reminiscences are currently at https://homepages.abdn.ac.uk/npmuseum/article/Daresbury.pdf.

the involvement of research students Penny Robertson and Sandra Lonie. We were joined later by Grzegorz Kowalski of Warsaw University. It was expensive research when the synchrotron beam-time was costed in but unfortunately the money went straight to Daresbury and not through the University. When the bean counters came to power, I was deemed to be doing only modest research as judged by the money brought in. It looks ridiculous in hindsight and it looked ridiculous then.



Stephen Clackson, John Pirie and John Reid with their X-ray scattering apparatus at the Daresbury Synchrotron Radiation Source in the early 1990s

In 1988 I was asked if I would give a centenary address to the Aberdeen Mechanical Society on their early years. This got me involved with the society, lead to the only book I've written (*Mechanical Aberdeen*) and over a decade later to my taking a 3-year turn as President and a longer period as Treasurer. It has been an interesting and valuable experience that has widened my contacts and my appreciation of engineering.

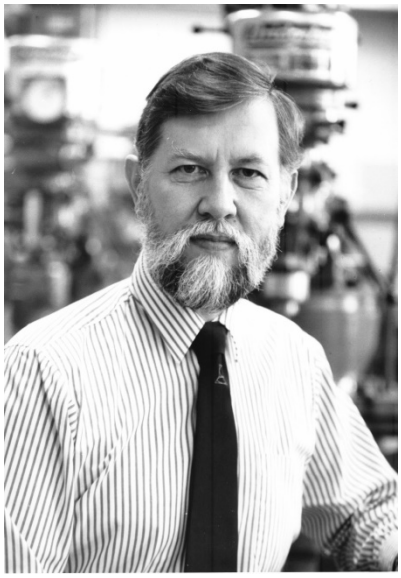
One piece of research that cost almost zero money was done by myself and Roger Clark, devising a new and accurate way to compute the X-ray absorption of single crystals. Unlike most of my work involving X-ray scattering by phonons, which was then a highly specialised field, this had wide applicability in X-ray crystallography. We reported the early results in a 1993 Congress in Beijing. Our paper of 1995 has since gathered over 1200 citations, more than most academics achieve. Without the interest in the minority subject, I would not have been thinking about X-ray absorption. Money is not a suitable proxy for research value, a mantra that will no doubt fall on deaf ears. For that matter, neither are citations accumulated. Most people who read never produce a single published citation in their life. Even academics read much more widely than the specialist topics in which they create citations. Nowadays even pure scientists, and I'd include myself here, are encouraged to produce articles, talks, web-pages and media appearances of social relevance. Very little of this material is formally cited, yet it is undoubtedly valuable. I have appeared by invitation on TV, on BBC and local radio. That's not even on my CV, let alone been cited. As I write this, I have items on the web across over 300 URLs, and that excludes my academic papers. Was it all worth doing? Certainly.

I have skipped past the troubles of the 80s, brought on by swingeing financial cuts to the University as a whole started by Sir Peter Swinnerton-Dyer's 1981 recommendations to the government. The Wikipedia article on him fails to mention this report and its damaging consequences across the higher education sector. At Aberdeen, Natural Philosophy was targeted as a special recipient of the cuts. The repercussions echoed through the 80s and

resulted in Professor Marr[6] taking early retirement and no further Professor of Natural Philosophy being appointed. Marr had been responsible for changing the name of the Department from Natural Philosophy to Physics in 1986, without consultation of staff. His now unfilled post as Professor of Natural Philosophy still exists.

Another government report came in 1988, this time by Sir Sam Edwards, another misguided Cambridge academic who thought his admittedly wide experience should be the foundation for how Departments over the whole country should be run. His report on *The Future of University Physics* resulted in closures of Physics departments across the country. By the early 90s, the Aberdeen Department was reduced to 'The Physics Unit', a supplement to the Department of Engineering. Unlike drowned companions, at least its head was still above water.

With the appointment in 1994 of Professor Hukins as MacRobert Professor of Physics, based in medical physics at Foresterhill, I became executive head of physics among the remaining staff at King's College. We had been thrown a life raft by the MacRobert Trust. Our task was to rebuild Honours Physics. Several circumstances helped considerably. By the early 90s modularisation had reached Aberdeen, making it much easier to run collaborative, interdisciplinary degrees. Additionally, the Institute of Physics had issued guidelines on how they saw a viable undergraduate degree being constructed, with the inclusion of a wider range of activities for students than lecture courses, tutorials and practicals. The added feature at Aberdeen was that the remaining staff agreed with the IoP analysis. No-one had a vested interest in maintaining the status quo. I collaborated with 7 departments in Science and Arts to set up 11 interdisciplinary Degrees involving Physics, where formerly there was only one. We were early adopters of putting most of our teaching material on the web, incorporating teamwork, poster sessions, web-page writing and even moderated peer assessment. Our new Honours programs were accredited by the Institute of Physics from the beginning. By the end of the century, the new, modern, Honours Physics and options were back on the map but it must have taken at least 10 years to restore our reputation outside the University – another lesson, that it takes misinformed opinion little time to knock down institutions but it takes a long time to build them back.



Other activities went on in the 1990s. Amongst them I enjoyed founding, writing and editing an alumni newsletter (*The Quantum*) which reached all continents on which we have Aberdeen Nat Phil/Physics alumni. That included Antarctica. At the same time I was involved in other quincentenary projects and, which I'd forgotten about until I recently cleared out an old filing cabinet, the early days of Techfest, Aberdeen's Technology and Science Festival that was promoted by Councillor Ray in 1992 and has flourished since then.

My memory of the 10 years before retiring in 2007 is of a lot of administration, a lot of paperwork and a lot of teaching. I particularly enjoyed writing and teaching the new versions

[6] For more detail on Professor Marr's tenure and a labelled photo of staff and students in the mid-80s, see https://homepages.abdn.ac.uk/j.s.reid/pages/Profs/Marr.shtml.

of the courses on Astronomy, Meteorology, Space Science, Optics and Cosmology. I also enjoyed reorganising and teaching the laboratories. The number of students taking physics courses pretty well doubled. Looking over my publications, there were about 20 papers in that period, mainly on topics connected with the history of science. I also enjoyed organising the conference with Charles Wang to celebrate 150 years of James Clerk Maxwell taking up his professorial post in Aberdeen. The attendance and events helped to publicise quite widely Maxwell's association with Aberdeen and my ensuing publications no doubt helped in being elected as a Trustee of the James Clerk Maxwell Foundation, a position I continue to value.

Since retirement I still have Honorary posts as Senior Lecturer in Physics and on the curatorial side of Museums and Special Collections. This has got me continuing to engage with some teaching, continuing the cataloguing of our Natural Philosophy Collection of historical scientific instruments, which has over 3000 items, presenting at conferences, writing papers, generating related web-page content and a miscellany of other contributions. I've particularly enjoyed the help in cataloguing from volunteer Hons students, almost all of whom have gone on to take post-graduate degrees somewhere in the UK, a few abroad.

Reflecting on my career, I am disappointed in some of the ways universities have evolved. I thought my generation could do better. On the positive side, universities now include a much wider range of skills in their degrees and are accessible to a bigger fraction of the population who used to miss out on tertiary education. Unfortunately, there is more to say on the negative side. Universities have become very stressful places to work. They didn't used to be. Inspiration and creativity are now managed within an inch of their lives. The tail seems to be wagging the dog, in that administration drives most activities, although academics have to pretend otherwise. Most research seems to be done by the temporarily employed, which is not a happy way to run the system; even the so called permanently employed have to spend a substantial amount of their research potential in selling their knowledge and ideas to justify their continuing existence; 'success' seems to be judged by specious measures and their ranking tables. The problem seems to be that those who fund research and who manage research staff have been asked to justify their allocation of resources. It seems an obvious and fair question but the honest answer is that the value of science is determined largely by posterity, which is the ultimate judge of whether knowledge gained has lasting value. A typical time between the publication of Nobel Prize winning science and the Nobel award is about 25 years, though there are exceptions. Management runs on short-term measures so they compile statistics like publication rate, journals used, number of recent citings of published work, etc., summarised by impact factors; they analyse questionnaires whose answers are compiled into ranking tables. They peer at their spreadsheets and pronounce. The net result is that broadly speaking science is not carried on in the first place for the benefit of science but for the benefit of satisfying management. In the second place it is carried on for the benefit of science. That's a sweeping simplification of how circumstances have developed over the decades of my career but anyone reading this will not be surprised that I've had no ambition to rise into the ranks of academic management. I've been far enough to see how it works, which is quite far enough.

To extend this digression for another paragraph, it seems to me that universities should be managed as universities, not as businesses. Most businesses fail, or are taken over. Few last a century. The ancient universities, of which Aberdeen is one, span the centuries. A better analogy would be to manage them as rolling expeditions into the future. Expeditions need

people who can think on their feet, adapt to changing conditions, improvise when necessary, have clear goals and internal cohesion but the freedom to define their own local way of working. I've been fortunate to be able to call most of my career 'an expedition'.

I was musing the other day that few people in university ever thank you for doing your job. Unfortunately, I can't now thank my Nat Phil undergraduate lecturers, for none are still alive. In truth, some were rôle models for how not to do the job – valuable examples, nonetheless, from whom I hopefully learned. The workshop staff have been brilliant throughout my career, highly skilled, willing to help in any circumstances, full of common sense and generally cheerful, even those who didn't whistle while they worked. I can thank all the lecturers who helped re-build physics here in the 90s and into the 2000s, and indeed the secretarial support from Doreen Tyre, who had seen us through the difficult 80s as well, Patricia Bonnefond, Anne McPherson and latterly Anne Gall. Secretary they may have been in title and salary, but they ran the discipline as much as any of us academics. I'll also single out Henry Barber[7] on the technical staff as someone whom I've been glad to know and work with for over half a century. I've known for not quite so long a good few other valuable colleagues on the technical side, including Gibby Shepherd[8] and Bob Mowat. Bob would say to me sometime 'John, you're too honest' when I didn't want to lock up something or wanted to lend out a useful piece of equipment expecting to get it back quickly. He probably meant 'too naïve' but was polite enough not to say so! Anyway, I've only once regretted trusting people and that incident wasn't in the Department. Naming names is probably a slope I shouldn't start on, for there are many others deserving a mention who have made half a century in the department largely a pleasure.

To have participated in the great adventure of scientific understanding has been a life worth living, hopefully one not at an end yet. Was it J M Barrie who said words to the effect that it's only work if you'd rather be doing something else? With that definition, I haven't done much work. I'm very pleased to have produced a balanced academic output of technical papers and conference proceedings, history of physics papers and proceedings, and public outreach contributions. Interviewers are wont to ask for 'achievements'. I've mentioned three technical papers in these reflections. Another paper, not discovered yet (!), is a very nice illustration of the effects of rotation and vibration on the X-ray scattering that I published with Moreton Moore and Lucy MacNay in 2007. An achievement that also gives me pleasure is raising from obscurity the profile of Patrick Copland, 18th century educator. The astronomer David Gill hadn't achieved obscurity but he had moved into the shadows and being able to shine some light on him with newly found material has also been interesting and worthwhile. My account in the Journal for the History of Astronomy of his early years was published 50 years after my first paper was submitted to the Journal of Physics. A record of persistence, if nothing else. A lot more happened both to me and others in the half century I've been on the staff than is covered in these reflections. Others will add to the Nat Phil, Aberdeen, story.

Honours Nat Phil, or Physics as I've now got used to calling it, has always been a minority sport here. Only in this century have graduate numbers gone into the 20s, though first year classes have always included hundreds. Added up for over 40 years, that still makes for a

[7] For an appreciation, see https://homepages.abdn.ac.uk/npmuseum/article/Biogs/hb.pdf.
[8] For an appreciation, see https://homepages.abdn.ac.uk/npmuseum/article/Biogs/gs.pdf.

good many students and most, I think, have left happy. Some have said that they liked being in a class small enough that they got to know the others and to know staff. Student friendly staff are a valuable selling point. I've also enjoyed introducing the wonder, power and range of physics to 'non-physicists', some of whom always ask questions that make you think. The biggest downside to retiring has been missing the students. The biggest upside has been the freedom from gratuitous administration. We could do with more trust from the ranks of administrators.

John S. Reid BSc, MLitt, PhD, FRAS, FRMetS, FInstP, CPhys

Feb 2019