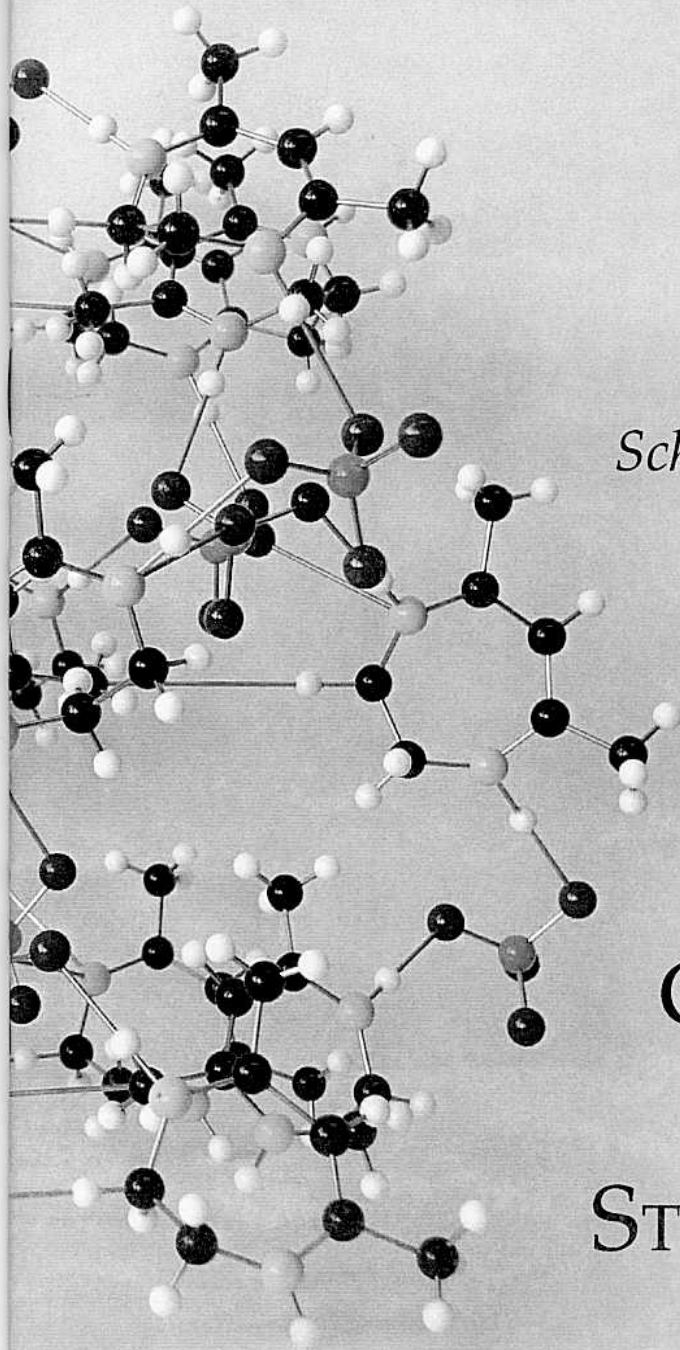

University of St Andrews

School of Chemistry

Chemistry In St Andrews

Douglas Lloyd

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2003

Introduction and Foreword

This booklet aims to provide a picture of the development of the School, earlier called the Department of Chemistry, in the University of St. Andrews, covering the teaching and research and especially the persons who contributed to them.

Inevitably it deals at greater length with the earlier years than the recent years, partly because the early period is less familiar to most contemporary people and also because it is difficult, if not impossible, to write about a contemporary situation without invidious images arising. In any case much concerning contemporary matters can be evidenced directly by other means.

The account of the first hundred and fifty years is divided into sections, many of them headed by the name of the relevant professor/head of department during the years it covers. This system is very applicable to the earlier part of this period when at any one time there was only one such professor in the Department, but the present day system of multiple professorships and varying Heads of School makes this methodology unsuitable and all the more recent times are dealt with in one final section entitled "Developments in the Latter Part of the Twentieth Century".

Science in the Earlier Days of the University

When St. Salvator's College in the University of St. Andrews was founded in 1450, Bishop Kennedy, the founder, said that his college should present students with the "pearl of science" and natural philosophy has been taught in St. Andrews ever thereafter. In St. Leonard's College there was an instruction that students should be offered study in "physic".

Instruction in mathematics and in natural philosophy has indeed been continuous since 1450 but it is probable that the latter had very little affinity with later experimental philosophy and rather consisted only of the study of Aristotelian philosophy. There is, however, tangible evidence of scientific activity in the University in the magnificent collection of early instruments, including the great astrolabe of Humphrey Cole, perhaps the finest extant Elizabethan scientific instrument, and in the clocks which belonged to James Gregory.

Furthermore, scientists of such great distinction as John Napier and Richard Gregory were members of the University. It may well be claimed that Napier, who matriculated in St. Andrews in 1564, is possibly the St. Andrean who has made the greatest impact on the world as a whole, as the inventor of logarithms and of the use of the decimal point.

The Development of Chemistry

Chemistry was not recognised as a discipline until the seventeenth century; the first professorship of chemistry in the world was established in Marburg (Germany) in 1609. The subject continued to develop and grew in succeeding centuries and at the end of the eighteenth and the beginning of the nineteenth centuries both theory and experimental work were expanding enormously.

Chemistry in St. Andrews started in 1808 with a legacy to provide the monies for a chair of chemistry. This came from a Dr. John Grey who was born in Cupar in 1724 and graduated in Greek in St. Andrews. The will did not take effect until Dr. Grey's death in 1811, but then some years passed before the chair was actually created; it was necessary for the money to mature in order to provide an adequate sum to finance the establishment of the chair.

The years 1808 and 1811 were both significant years chemically, the former saw the publication of Dalton's Atomic Theory and the latter Avogadro's Hypothesis. There were indeed strong grounds for the foundation of the chair of chemistry in Scotland's oldest university for at this time chemistry was beginning to make itself felt both intellectually and industrially. Intellectually, not only were Dalton and Avogadro making their contributions, Davy, Faraday and many others were also at work. On the industrial scale, in Scotland a number of chemical plants had been erected, especially in the west, to make, among other things, bleaching powder (a Scottish invention), sulphuric acid and acetic acid (the latter from wood).

Robert Briggs (1811-1840)

Although Grey's will could not finance a chair in chemistry in 1811, chemistry was nonetheless taught in St. Andrews from that date. A chair of medicine which had been founded in 1721 had always been somewhat of a sinecure and in 1811 a Dr. Robert Briggs was appointed to this chair and was requested to teach pharmacy and chemistry.

In the event 32 students enrolled for his first chemistry class and Dr. Briggs gave lectures on chemistry for nearly thirty years; in 1827 it was accepted as a formal examination subject. A separate Faculty of Science was not created until 1897, although the degrees of Bachelor of Science and Doctor of Science were instituted in 1870 and put under the control of a special Science Committee. It is interesting to note that the Principal of St. Mary's College in the University, which catered for the theological students described chemistry as "indispensably necessary".

However conditions for chemistry were initially primitive. There was no laboratory and no apparatus. A classroom was found in the old west wing of St. Salvator's College quadrangle, which was then in a ruinous state and was later pulled down. In evidence provided to the University Commissioners in 1827 it had been stated that there was no heating in the building and that it was dangerous to go into it in stormy weather. The building had been the old St. Salvator's College library but had been partitioned to form a students dining-room, and to reach chemistry it was necessary to pass through the dining room.

Since there was no laboratory and very little apparatus, teaching had perforce to be theoretical. Students were indeed expected to analyse samples of minerals at home; one wonders at the landladies (or bunkwives as they were known until recently) of nearly 200 years ago – were they really willing to have students boiling up minerals in aqua regia in their kitchens?

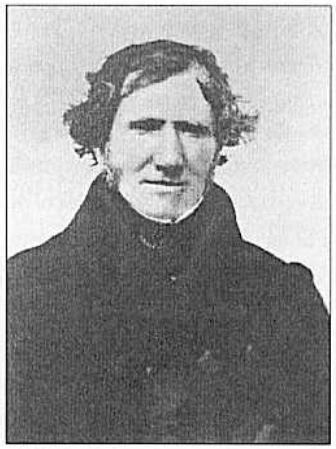
Rather surprisingly the University authorised the Quaestor to attend a sale of chemical apparatus being disposed of in Glasgow and to make purchases up to £40. The purchases included a fine balance with weights, possibly dating from 1750, which is still in the possession of the School.

Foreshadowing what are commonly thought of as contemporary ideas of continuous assessment, Briggs held examinations almost every day. "Only gentlemen who had been in the army, and divinity students, declined to take them."

Despite all the handicaps, at least one distinguished chemist emerged from these classes, namely Dr. Lyon Playfair, who became Professor of Chemistry at Edinburgh and was one of the founders of the Chemical Society and a leading promoter of the 1851 Exhibition. There is record of his carrying out his practical work at his home, struggling with pot and pan to extract sugar from beetroot.

Arthur Connell (1840-1861)

In 1838 the University for the first time appointed a scientist as Principal, Sir David Brewster, who was an early investigator of polarised light, and chemistry no longer languished as an outcast subject. The original endowment for the Chair of Chemistry had now accumulated a sufficient sum and at last in 1840 the first specific Professor of Chemistry was appointed. This was the first new Chair to be established in the University since the union of St. Salvator's and St. Leonard's Colleges in 1707. The first incumbent was Dr. Arthur Connell, who had studied, in turn, chemistry at Edinburgh, philosophy at Glasgow and law at Balliol College, Oxford. To quote another former professor of chemistry at St. Andrews: "although qualified as an advocate he never practised Law; he was attracted to the bench, but it was a chemical one".



ARTHUR CONNELL

From a calotype by John Adamson, ca. 1842

By this time chemistry had emerged into something more like its modern form, for in the previous years the phlogiston theory had been exploded and replaced by the concepts of oxidation, and Dalton's atomic theory had been vindicated. Organic chemistry had become a

thriving infant, nurtured by Berzelius, Liebig, Wöhler and others. The Chemical Society was founded in London in 1841; the present-day Royal Society of Chemistry is its sole heir and successor, and was formed in 1980 from an amalgamation of it with the Society of Analytical Chemistry (founded 1874), the Royal Institute of Chemistry (founded 1877) and the Faraday Society (founded 1903).

Connell was an authority on mineral analysis and also, influenced by the then recent work of Faraday, made incursions into electrolysis; indeed the first scientific publication to originate from the new Department of Chemistry, in 1840, was on an electrochemical topic.

At about this time St. Salvator's College quadrangle was rebuilt much as it is now and the old home of chemistry was demolished. New quarters were found in the present quadrangle buildings and must have seemed palatial after the old. There was a proper lecture room with a demonstration bench, together with another small room to serve as laboratory, preparation room, research room and store.

Connell was obviously an active chemist for he published 40 original papers in the Proceedings of the Royal Society and in 1855 he became the first St. Andrews professor of chemistry to be elected to Fellowship of that Society. His lecturing was described by one of his pupils as follows: "His style and manner of lecturing was that of a cultured gentleman - cultured after the manner of an Edinburgh advocate, seldom wanting in elegance and never in accuracy".

Connell was afflicted with poor health following an accident and in the years 1849-1852 John Adamson, who taught chemistry in the town school, Madras College, acted as a stand-in. As a result of this the Department can claim connexion with early photography. Fox Talbot, inventor of the calotype process in photography, had visited Principal Brewster early in 1840 and met Adamson, who himself became one of the notable early pioneers of photography. An early portrait of Connell (*ca.* 1842) is by Adamson; this could well be the first ever photograph taken of a professor of chemistry.

Matthew Forster Heddle (1862-1883)

As a consequence of Connell's ill health an assistant, Matthew Forster Heddle, was appointed in 1856. In 1862 Connell retired and Heddle was appointed to the chair.

MATTHEW FORSTER HEDDLE

Heddle was another mineralogist, and one of outstanding distinction. On the whole though, the appointment of Heddle appears to have been a rather backward-looking choice. At that period the almost explosive development of organic chemistry was the great growth point in chemistry – this was the era of Kekulé, Couper, Bunsen and Perkin, among many others. Little change or growth appears to have taken place in the Department in St. Andrews during Heddle's period in the chair and students were few in number. He is said to have had a rather dramatic style of lecturing. His greatest fame was, and still is, as a collector of rocks and the Royal Scottish Museum in Edinburgh now houses the magnificent Heddle Collection of more than nine thousand specimens of Scottish rocks.

Nonetheless some distinguished students emerged from the Department, three to attain professorships and another to be a pioneer of chemical industry in the U.S.A. and the founder of one of the larger U.S. chemical companies. The name of this latter student was preserved in St. Andrews by a Matheson Scholarship and a Matheson bursary.

Thomas Purdie: Part 1, as a Locum (1882-1883)

The most notable student of Heddle's period as professor was Thomas Purdie, after whom the present chemistry building is named. He was an older student than most of his fellows, having previously spent seven years as a cattle rancher in the Argentine. After leaving St. Andrews he went on to work with the distinguished chemist Edward Frankland in London and with Johannes Wislicenus in Wurzburg. He was later appointed as County Analyst for Staffordshire. On a summer visit to St. Andrews in 1882 he chanced to meet the Principal of the University while out walking on the Scores. The latter asked him if he would be willing to stand in at St. Andrews for one year to enable Heddle to visit South Africa on a government mineralogical survey. Purdie accepted this invitation. The locum was extended for a second year (1883). Then in 1884 Heddle's health failed. The chair of chemistry became vacant and Purdie was elected to fill it.

A Second Department of Chemistry in the University of St. Andrews (1882)

An important event in the University of St. Andrews took place in 1882. University College, Dundee was founded as a constituent college of the University of St. Andrews. A Department of Chemistry and an associated Chair of Chemistry were established in this College, so that there were now two Departments of Chemistry in the University of St. Andrews. The first professor in this new Department was Thomas Carnelley, appointed in 1883; at the time of his appointment he was professor of chemistry at Firth College, Sheffield, now the University of Sheffield, having been the first professor of chemistry to have been appointed there. He built up a thriving department at Dundee and his successor in 1888 was Percy Faraday Frankland, who was a son of Edward Frankland, and was a close friend of Thomas Purdie. Although they maintained relations with one another, the two departments developed quite independently and for this reason the subsequent history of the Dundee department will not be considered further in this present account, which deals solely with the development in St. Andrews itself. The Department in Dundee has had some highly respected professors and has been in turn part of University College Dundee, Queen's College Dundee, as it was renamed in 1954, and the University of Dundee, as it became in 1967.

Thomas Purdie: Part 2, as Professor (1884-1908)

Purdie's appointment to the chair in St. Andrews was a turning point in the history of chemistry in St. Andrews and he was the man who, above all, set the St. Andrews Chemistry Department on its road to greatness. It has indeed been said that "it was not too much to claim it was also a turning point in the history of the University".

THOMAS PURDIE

Purdie was a man of vision who also blended vision with action. He realigned the department from mineral analysis and mineralogy to chemistry, in particular to organic chemistry, and to the then still newer field of stereochemistry.

In his inaugural address he said: "I venture to hope that I may have some students who will be willing to give the time required for original investigations, and I promise them that, whether the results that they may obtain may be of scientific value or not, they themselves will be rewarded, for among all methods of scientific training, there is none of such high educational value as research. ..... Might it not be possible to remain in St. Andrews during the summer

months and undertake some original investigation, the results being published in the joint names of professor and student, and as contributions from the United College, St. Andrews?"

These words, spoken in 1884, are certainly the voice of a later century and heralded a new outlook in chemistry. When the conditions which were available to Purdie are considered, this was a real act of faith, for his department was still only that occupied by his predecessors, namely one lecture room and one other room.

From the very start he introduced a systematic study of organic chemistry into his lectures without, however, any sacrifice of attention to the older traditional inorganic chemistry. His own particular interest was the, at that time, pioneering subject of stereochemistry, and especially in the study of optical activity, which was then in its infancy. At that time any optical resolution was a novelty and an achievement. Assisted by voluntary labour from students, Purdie resolved many simple acids. Most notably he achieved the first resolution of lactic acid, which occupies a focal point in stereochemistry, by successive recrystallisations of its zinc ammonium salt.

Not only was this work done by voluntary student labour, it was also carried out either in the summer months or, for the rest of the year, in the small hours, since only one laboratory was available and during term time everything had to be cleared away ready for the use of the laboratory during the daytime as a teaching laboratory.

Purdie's zeal for research was not allowed to interfere in any way with the conscientious performance of what he regarded as his first duty, namely the teaching of undergraduates. This he did so supremely well that the quality of his teaching, his enthusiasm and his sincere and unaffected interest in students inevitably attracted students to him. Many students from other faculties voluntarily attended his lectures. He was a great believer in elaborate lecture demonstrations, which were carried out on as large a scale as possible and sometimes even more striking than he expected, as once when the demonstration of an underwater explosion necessitated the majority of the class to make hastily for their lodgings in order to change into dry clothes.

Purdie was also responsible for the provision of a new chemistry building which served chemistry in St. Andrews until 1968; this was entirely a consequence of his love of research. This building, now occupied by the School of Geography and Geosciences, was vacated by chemistry when it moved to its present home in the Purdie Building, a happy choice of name for this present building.

CHEMISTRY BUILDING ORIGINALLY
PROVIDED BY THOMAS PURDIE

The first step towards the provision of the new building by Purdie came in 1891. A widowed aunt of Purdie gave, in memory of her late husband, Thomas Purdie of Castlecliffe, a laboratory to accommodate practical chemistry. This modest one-storey building was later incorporated into a larger building. In this laboratory Purdie made his most significant contribution to chemistry, the discovery of the silver oxide/methyl iodide method of methylation of hydroxyl groups. This reaction was later applied by Purdie and his colleague and former student, Irvine, to sugars and provided perhaps the most important single tool for the early elucidation of the structure of sugars and other carbohydrates. So started a school of

carbohydrate chemistry which made St. Andrews world-famous in the first quarter of the twentieth century. St. Andrews became the home of carbohydrate chemistry and was the progenitor of many other related research schools throughout Britain and the world.

At the turn of the century Purdie's research school was rapidly taking shape and in 1900, thanks to a legacy from a rich uncle, he offered to build and equip a research laboratory and a lecture theatre, and to provide an endowment for its maintenance. This was added to the north end of the already existing one-story building and the resultant edifice still remains as a University building, the Irvine Building.

It is interesting to note that, thanks to the generosity of the Purdie family, the University paid almost nothing for this chemistry building, except for two minor additions and, furthermore, that a substantial part of the running costs were met from Purdie's endowment. In addition Purdie paid Irvine's salary for a time in order to retain him as a colleague in St. Andrews.

The construction of this building in 1905 was not only an act of great generosity but also once again of great faith, for this was the first such research institute in Scotland. It was then occupied by up to eighteen graduate research workers. Purdie refused to have an opening ceremony saying "better the end of a thing than the beginning thereof". Now that chemistry has completed its connexion with his building one trusts that Purdie would not be ashamed of the results that he and his successors achieved in it.

Another notable event of 1905 was the founding of the St. Andrews University Chemical Society. The stated object of the Society was to foster a spirit of scientific enquiry among students of chemistry in the University and to afford opportunity for the discussion of chemical problems. Sixteen members were enrolled at the inaugural meeting and since that day the Society has had an uninterrupted and flourishing existence.

James Colquhoun Irvine, Part 1 (1909-1914)

Failing health compelled Purdie to retire in 1909. He was followed by James Colquhoun Irvine, Purdie's most brilliant research pupil and co-worker, who was selected from a particularly strong field of candidates, testifying to the standing of chemistry in St. Andrews.

JAMES COLQUHOUN IRVINE

Irvine had come as a student to St. Andrews in 1895. After he had graduated B.Sc. he was encouraged by Purdie to spend some time in one of the distinguished German schools of chemistry where he could gain a Ph.D. degree. As a result, Irvine worked with Wislicenus in Leipzig. Whilst he was in Leipzig, Irvine conceived the idea of applying Purdie's silver oxide/methyl iodide reagent to the investigation of the structure of carbohydrates. Purdie was impressed with this suggestion and he invited Irvine to return to St. Andrews when he had completed his period in Leipzig in order to pursue this novel work in carbohydrate chemistry. Purdie also largely financed Irvine to enable him to do so.

Irvine was appointed as a lecturer in 1902. In 1909 failing health had compelled Purdie to retire and Irvine was appointed as his successor. Under Irvine's direction the carbohydrate school continued to flourish and gained a great international reputation. He was greatly helped by the Carnegie Trust, who made possible the payment of research workers.

The Department in the First World War, 1914-1918

The first world war, 1914-1918, brought an interruption to the normal work being carried out in the Department and instead chemical investigations on behalf of the war effort supervened. A variety of topics were involved, some related to the carbohydrate skills of the department, for example the preparation of various carbohydrates for which there was a national need, such as dulcitol. Other work was unrelated to carbohydrates, for example investigations concerning the production of acetone, which was urgently needed in greater quantities, and also the preparation of various other compounds which were needed in greater amount by the country, for example novocaine. The department became something like a chemical factory, making these various compounds, and nearly one hundred persons, some from the department but some also from other parts of the University and also from the town worked in day and night shifts.

James Colquhoun Irvine, Part 2 (1918-1921)

After the war normal academic work resumed and among Irvine's collaborators at this period were two who were to become famous chemists of distinction and added much lustre to the name of St. Andrews.

One of these was W. N. Haworth, later Sir Norman Haworth, one of two Nobel prize winners who have been associated with the St. Andrews Department. He held a senior lectureship in the department from 1912 and entered the field of carbohydrate chemistry. He later (1921) left St. Andrews to take a Chair of Chemistry at Newcastle-upon-Tyne and then moved on to Birmingham, where he founded a famous school of carbohydrate chemistry, directly derived from the St. Andrews tradition. Whilst he was in St. Andrews, Haworth was also responsible for introducing the concept of conformation, which has later achieved enormous use and value throughout chemistry.

The other collaborator of Irvine in carbohydrate chemistry who was to gain great distinction was E. L. Hirst, later to become Sir Edmund Hirst. Hirst was very much a local product, attending school at Madras College in St. Andrews and then gaining M.A., B.Sc. and Ph.D. degrees in St. Andrews, the latter under Haworth as supervisor. At the end of his first year at University he seriously considered changing to an honours degree in classics but the War was

responsible for directing him firmly into chemistry when he became one of the team of workers in the chemistry department. His first practical introduction to chemistry was the preparation of dimethylamine from dimethylaniline, but in his second year he had his first taste of carbohydrate chemistry, and he remained in that field for the rest of his life. When Robinson (see next section) moved to Manchester in 1923 he invited Hirst to join the staff there, where he briefly worked in collaboration with A. Lapworth and Robinson, but in 1924 he moved to Newcastle to rejoin Haworth. He then moved with Haworth from there to Birmingham. Here he achieved fame by elucidating the structure of vitamin C, ascorbic acid, and synthesising it – the first vitamin to be synthesised by man. He later held Chairs at, in turn, Bristol, Manchester and Edinburgh.

In 1920 Irvine was appointed Principal of the University of St. Andrews. Although having to resign from his professorship he continued to maintain an active interest in chemistry and continued to supervise research work and publish papers throughout the 1920s and 1930s.

Robert Robinson (1921-1923)

ROBERT ROBINSON

Irvine's successor was Robert Robinson, later Sir Robert Robinson. He had previously held chairs at Sydney and at Liverpool. Robinson was one of the greatest organic chemists of all time and arguably the outstanding figure of the years between the two world wars (1918-1939). He is the second of the Nobel Laureates who were associated with the St. Andrews department. He had a strikingly wide range of chemical interests. He was particularly famous for his work on the structure, synthesis and biosynthesis of natural products and on the concept of the application of electronic theories to the mechanisms of organic reactions. The records of the University of St. Andrews Chemical Society in 1922 show that these theories were already developing in his mind. In all this work, and in the manner in which he taught organic chemistry, he was much ahead of his contemporaries, and when he was at St. Andrews he was at the height of his powers and some of his most noteworthy contributions to chemistry date from this period. With Irvine also still involved in chemical research and many other co-workers who later achieved distinction, the early 1920s must have been an incredibly exciting time to be in the chemistry department at St. Andrews. In 1922 thirty publications emanated from the department, a remarkable total for that period of time from a small University. A wide range of topics was covered, including mechanism of organic reactions, the electronic basis of organic reactions, absorption spectra, mechanisms of mutarotation, monosaccharides, polysaccharides, reactions of halogen substituents in organic molecules, alkaloids, pyrylium salts, anthocyanidins and polycyclic heterocycles.

At this early date the interest in mechanistic organic chemistry is particularly noteworthy; these concepts were also introduced in Robinson's lectures to undergraduates. Hirst recalled especially the complete revolution in the attitude to theoretical chemistry consequent on Robinson's arrival. It was in his honours lectures in St. Andrews that he first enunciated his ideas of the aromatic sextet.

The concept of the aromatic sextet was possibly the most influential contribution. It is interesting to read his original words, remembering that they were written eighty years ago. "The explanation is that six electrons are able to form a group which resists disruption and may be called the aromatic sextet. It is not supposed that the existence of the sextet involves a change in the total valency exerted by the carbon atoms of the ring nor does the theory as employed ..... require any particular assumption in regard to the position of the electrons or their orbits in

space." Armit* and Robinson then suggested the inscribed circle formula for benzene. They also added: "The unsaturated nature of cyclooctatetraene suggests that a stable group of eight electrons analogous to the aromatic sextet is not formed."

Robinson was inevitably destined for larger places and he left in 1923, becoming professor at, in turn, Manchester, University College, London and Oxford, but he looked back on his time in St. Andrews with affection.

John Read (1923-1963)

Robinson was followed as professor in St. Andrews by John Read, who had also followed him in the chair of chemistry at Sydney. As a young man at London, Zürich and Cambridge, Read had become deeply involved in stereochemical problems and was a pioneer in the use of optical rotatory dispersion. He was the first person to resolve a carbon compound having only one carbon atom [$HC(Cl)(I)SO_3H$]. In Australia he also developed an interest in terpenes obtained from oils extracted from the Australian flora. In St. Andrews he continued to work on these topics of stereochemistry and of the structure of terpenes. He was an excellent lecturer and teacher and his textbooks achieved a world-wide use and ran into many editions.

* Armit was a St. Andrean, who lived in a bakery in Church Street. Until fairly recently a glass pane in this shop had a small inscribed circle formula of benzene cut on it by a glass-knife, possibly the first public display of this formula! Unfortunately it was lost in a reconstruction of the shopfront.

JOHN READ

He was also renowned as a historian of chemistry and alchemy, possibly being the greatest authority in the world on this subject at that time. To him in particular, although not to him alone, the department is indebted for a priceless collection of historic books and manuscripts. The oldest is a first copy (1477) of the first printed work by any Scots scientist, appropriately named Michael Scot.

In Read's time the rise of physical chemistry was marked by the first appointment, in 1927, of a lecturer in physical chemistry, J.Y. Macdonald. During the later years of Read's professorship there was an unofficial understanding with the Department of Chemistry in Dundee that St. Andrews would concentrate on organic chemistry and Dundee on physical chemistry and this situation was maintained until the middle of the twentieth century. Joint degree examination papers for both departments, each being a constituent department of the University of St. Andrews, were the practice and in these matters again the St. Andrews department oversaw the production of the organic papers and Dundee the physical papers.

One of the hardest struggles during Read's professorship was to obtain the extended space needed to match up to the big developments of the subject. From 1932 onwards Read sought continually to provide new facilities in a new building, but sadly he did not live to see this fulfilled.

In 1939 World War 2 broke out and intervened and affected all British chemistry departments. Physical scientists were obviously needed and chemistry was rated as a reserved occupation, so that students in the physical sciences were not called up for military service and on graduation were directed to work which made use of their chemical/physical knowledge and skills. In most of the larger departments of chemistry research teams were set up to pursue special work associated with the war effort.

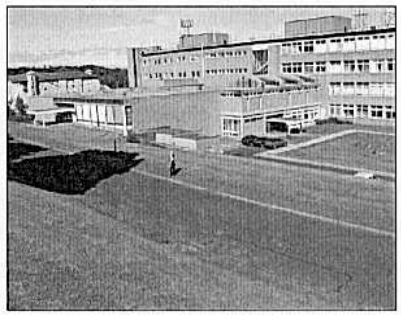
However, St Andrews was not big enough to contribute to this scheme, and its isolated position, away from chemical industry, was also a barrier. Undergraduate teaching continued but considerable problems arose. At the outbreak of war there were five members of academic staff, one of whom, Dr. Ettie S. Steele, doubled as Principal Irvine's personal secretary (and also as warden of McIntosh Hall). In 1940 two other members of staff were lost. One died and the other was seconded to the A.R.P. (Air Raid Precautions) service, leaving John Read, James Y. Macdonald and Ettie Steele, to cope with all teaching and associated duties in the department. These three taught, respectively, all the organic, all the physical and all the inorganic chemistry, lectures and laboratories. Practical research had perforce come to a temporary standstill. John Read helped to keep some research interest going thanks to his interest in the history of chemistry, but time for anything other than the necessities of teaching was obviously infinitesimal.

At the end of the war John Read started to rebuild normality in the department. New members of staff were brought in (H.T. Openshaw, organic, alkaloids, 1946; D.M.G. Lloyd, organic, non-benzenoid aromatics and ylides, 1947; C. Horrex, physical, gas-phase kinetics, 1947; A.R. Battersby, organic, alkaloids, 1948; H.C.S. Wood, organic, alkaloids, 1950 and A.G. White, inorganic, 1951) and research students reappeared. Openshaw later left to become head of chemical research at Burroughs Wellcome, Hamish Wood became professor at Strathclyde University and Alan Battersby took up a lectureship at Bristol and was then Professor of Organic Chemistry at, in turn, Liverpool and then Cambridge.

During the next dozen years further appointments were made. In particular extra posts were created in physical chemistry and in the 1962-63 session there was a full-time staff of eleven (1 inorganic, 4 organic, 5 physical, 1 first-year). New research subjects brought in by these appointees included studies of fats and fatty acids by F.D. Gunstone (later appointed to a personal chair in St. Andrews), novel polycyclic heterocycles by D.H. Reid (who left in 1985 to take up the chair of organic chemistry at the University of Witwatersrand) and polymer chemistry by G.G. Cameron (who left in 1966 and became professor of physical chemistry at Aberdeen).

John I.G. Cadogan (1963-1969)

John Read was the last holder of a chair of chemistry in St Andrews with life tenure and he died in office in 1963. He was followed (1963) by John I.G. Cadogan (now Sir John Cadogan), who came to St. Andrews from King's College, London, bringing with him research interests new to St. Andrews, in the study of free radicals, reactive intermediates and phosphorus compounds. The arrival of a young, enthusiastic Head of Department provided a great stimulus to chemistry in St. Andrews. More new academic staff were also brought in, in all branches of chemistry, including the first appointment of a theoretical chemist. At the beginning of session 1968-69 the total number of academic staff had risen to twenty (4 inorganic, G.S. Harris, R. Hulme, T.M. Shepperd, D.R. Williams; 7 organic, J.I.G. Cadogan, F.D. Gunstone, D.M.G. Lloyd, R.K. Mackie, D.H. Reid, J.T. Sharp, D.M. Smith; 1 physical organic, A.R. Butler; 6 physical, D. Calvert, C. Horrex, J.R. MacCallum, C.A. Vincent, G.R. Woolley, P.A.H. Wyatt; 1 theoretical, C. Thomson; 1 first-year, (Mrs) P.A. Sugden).



PURDIE BUILDING

There was also an influx of modern apparatus and instrumentation including, for example, in 1964, the first NMR spectrophotometer in the Department of Chemistry. And to support all this, at long last the Department was provided with a brand new up-to-date building into which it moved in 1968. This is the present Purdie Building, very appropriately named after the eminent earlier professor. In 1968 it cost £2 x 10^6 (at 1968 rates). This large building, which contains > 120,000 square feet of floor space, has proved to be a very successful building. Externally it is very much, although not entirely, in the form in which it started but various modifications have been made internally to adopt it to modern and changing needs. Most recently (1998), a large Biomolecular Sciences Building has been annexed to it to enable work to expand in the frontier areas between chemistry, biochemistry and medical sciences.

With new staff and apparatus and facilities and a new building there were just the conditions to provide inspiration and both teaching and research flourished, for example the annual number of publications more than doubled from 1963 to 1967.

Development during the latter part of the twentieth century (1968-2000)

A noteworthy event in 1968 was the creation of a second chair of chemistry; Peter A.H. Wyatt, a physical chemist, was appointed as Irvine Professor of Chemistry and the first holder of the newly created chair. This implied and brought about a significant change in the Department. No longer was there a single professor at the head of the department; hereafter the headship of the Department was not embodied in one person but rather it rotated among more than one professor.

Peter Wyatt's research interests particularly involved various aspects of the physical chemistry of protic solvents.

In 1969 John Cadogan was invited to move to the chair of organic chemistry in the University of Edinburgh. After some years in Edinburgh he moved from there to become, in turn, Chief Scientist at B.P. Research Centre, Director of Research for the B.P. group world-wide and Director General of Research Councils, and also he was Visiting Professor at Imperial College, London. He is now Science Policy Advisor to the Irish Government.

His successor to the Purdie Chair of Organic Chemistry was yet another John, the Lord Tedder, who was at that time Professor of Organic Chemistry in the University of Dundee, this latter institution having been formed in 1967 when it evolved from what had previously been University College & later Queen's College, Dundee, and as such had previously been an integral part of the University of St. Andrews. John Tedder's move to St. Andrews could thus almost be regarded as an intercollegiate move within the University of St. Andrews from Queen's College, Dundee to the College of St. Salvator and St. Leonard, St. Andrews. He brought with him, in particular, interests in radical chemistry and physical organic chemistry. He was also senior author of a series of excellent novel and successful textbooks of organic chemistry.

John C. Walton also moved from Dundee to St. Andrews and he has continued his own field of radical chemistry. He was responsible for the development of ESR spectroscopy in the Department of Chemistry in St. Andrews.

In the following period up to 1985, two more current members of staff, C. Glidewell and R.A. Aitken, inorganic and organic chemists respectively, joined the staff of the Department.

The mid-1980s brought another turning point in the story of the Department for it lost the services of both the Purdie and Irvine Professors. Peter Wyatt reached his retirement in 1985 whilst John Tedder was laid low by illness; his official retirement came in 1988.

An inorganic chemist, David Cole-Hamilton, succeeded Peter Wyatt as Irvine Professor and he set about building up the contribution of inorganic chemistry in St. Andrews, a branch of the subject which had hitherto been a rather neglected area there. His own interests centre on a wide variety of organometallic compounds and especially on their uses as valuable catalysts.

In 1988 the award of Honours B.Sc. degree in chemistry in the University of Stirling was discontinued and members of staff moved to other Scottish universities. Under this arrangement R.W. Hay and D.T. Richens (inorganic) and F.G. Riddell (organic) joined the Department in St. Andrews.

At about this period, the attitude of the University of St. Andrews to professorships changed. Previously the term professor had been in effect synonymous with that of 'head of department'. This now no longer obtained and persons might be appointed to professorships

which held no such implications. In consequence members of staff might be promoted to personal professorships and new members of staff might be appointed as lecturers, readers or professors, depending upon their seniority and/or academic standing.

At the time of writing (session 2002-2003) the School of Chemistry, as it is now designated, has 30 full-time members of academic staff and in addition five emeritus or honorary members of staff. The traditional designations as inorganic, organic and physical chemistry are now often no longer apposite or generally applicable, since contemporary practice and research in chemistry is commonly much more interdisciplinary and involves facets of each of the older divisions, but the academic staff can be classified roughly as follows:

Inorganic - D.J. Cole-Hamilton, J.A. Crayston, C. Glidewell, D.T. Richens, J.D. Woollins; and G.S. Harris.(honorary)

Materials Science - P.G. Bruce, J.T.S. Irvine, P. Lightfoot, R.E. Morris, P.A. Wright, W. Zhou; and C.A. Vincent .(honorary; presently Vice-Principal of the University)

Organic - R.A. Aitken, N.P. Botting, A.R. Butler, R.K. Mackie, D. O'Hagan, D. Philp, F.G. Riddell, D.M. Smith, J.C. Walton, N.J. Westwood; and F.D. Gunstone (emeritus) and D.M.G. Lloyd (honorary).

Physical - F.M. Gray, J.R. MacCallum (emeritus)

Structural Biology - J.H. Naismith

Surface Chemistry - C.J. Baddeley, M. Buck, G. Hähner, N.V. Richardson.

Theoretical - W.C. Mackrodt.

X-Ray - A.M.Z. Slawin

First-year Classes - S. Seth

There are further changes in the academic staff from session 2003-2004, following the retirement of A.R. Butler, R.K. Mackie and D.M. Smith and the appointment of M. Clarke and S.J. Conway (both organic).

Professor Neville Richardson is the current Head of School.

There are also approximately 40 postdoctoral and approximately 90 postgraduate research workers and approximately 20 support and secretarial staff.

During the period 1985-2000 a number of appointments were made in Chemistry, some of whom spent relatively short periods in St. Andrews including K.D.M. Harris (1989-1993), D. Gani (1990-1998), S.W. Homans (1994-1999) and R.A. Field (1994-2000), all of whom moved on to professorships in other universities. G. Taylor was appointed to a chair in chemistry as an X-ray biologist in 1999 but was transferred to the School of Biology in 2002, but continues to work in the Biomedical Science building annexed to the Purdie Building.

At present study for an Honours B.Sc. degree requires four years of broad-based teaching and this may also be carried out in conjunction with other subjects. A short research topic is undertaken near the end of this course by all students. They may also opt to spend a short period in industry during the course, in order to gain an introduction to and impression of industrial chemistry.

Additionally students may work for an M.Chem. degree, requiring five years of study, one of which is spent in an industrial placement that may be in Britain or overseas.

Two research degrees are available, an M.Phil. and a Ph.D., which respectively involve one and three years of research work.

The School has been rated highly for both teaching and research, achieving ratings of "excellent" for the former and Grade 5 for the latter. In the year 2000 a total of 155 scientific publications in reputable journals was achieved; since the initial founding of the Department of Chemistry it has produced well over three thousand such publications.* Perusal of the list of publications shows that while the traditional strength in organic chemistry, including synthesis, mechanistic and biological related, has been maintained, fields newer to St. Andrews, especially in the newer branches and developments of chemistry such as biological chemistry, materials science, surface science, organometallic chemistry and electrochemistry, have been developed; this wide range of study, coupled with its quality, has contributed to the high research rating achieved by the School.

* A full list of these publications is available at http://chemistry.st-and.ac.uk/Pubs/

In 1998 a new and large separate building, the Biomolecular Sciences Building, adjacent and annexed to the Purdie Building, was completed, designed to enable work to expand in the frontier areas between chemistry, biochemistry and medical sciences.

Another new and exciting development in 2002 has been the sharing of some laboratories and facilities with the outstanding South African firm Sasol, which is a world leader in the commercial production of liquid fuels and chemicals from coal, including low grade coal, and crude oil, and also in the conversion of natural gas into environment-friendly diesel and chemicals. As part of its globalisation policy Sasol was anxious as well to expand its research and development in organometallic chemistry worldwide. It also wished to provide an opportunity for intellectual contact with academic chemists who have similar interests. After a careful assessment of possible means of achieving this they decided to look at the possibility of establishing such a research centre in St. Andrews, having been impressed with the facilities, especially analytical, available and its worldwide reputation in homogeneous catalysis, which would be an invaluable point of contact. Their wish is to found in St. Andrews a research facility focussing on more fundamental aspects of the core subjects involved. They already have eleven active research workers in St. Andrews and hope to expand their team to 25 members. Although being an independent British facility they wish also to be a satellite of their main South African research laboratories.

This development provides another new venture for the School of Chemistry which can look forward to it with great interest and pleasure. It provides an exciting possibility for academic and industrial chemists to work as neighbours and it is hoped that both groups will gain much by friendly contact and mutual discussion which it makes possible. All this should also serve to stimulate the teaching of chemistry and provide a feature of interest to undergraduates in the School.

The School of Chemistry in St. Andrews thus has the pleasure of being a thriving and flourishing entity in which both high quality teaching and research can take place, creating thereby an exciting, encouraging yet friendly atmosphere which bodes well for all concerned, students, academic staff and all the associated research and other workers therein.

It seems appropriate to end this account with an excerpt from a lecture given by Principal Sir James Irvine in 1940 to mark the centenary of the Department of Chemistry in St. Andrews:

"My own special gratification comes from the reflection that so many of our students have been quick to enter into the spirit which from the beginning has actuated this Department.

What is that spirit? It would be easier to define it in terms of what it is not – and it is certainly not the study of Chemistry as a preparation for examinations leading to a degree; nor to become a chemist merely because of the reasonable certainty of earning a livelihood, or the possible hope of amassing a fortune. The spirit of this Department, the spirit of all scholarly chemistry, is reflected in the virtues of accuracy, honesty, endeavour and adventure, coupled always with a just appreciation of what is owed to the past: Accuracy and Honesty – so that all we do will stand the test of time; Endeavour – for the reason that the exercise of every effort is needed for the making of a chemist; Adventure – for without adventure research becomes mechanical repetition. The exercise of these scientific virtues has fortified many generations of St. Andrews students – not all of them chemists – who in after-life have good reason to bless the day they entered this century-old Department".

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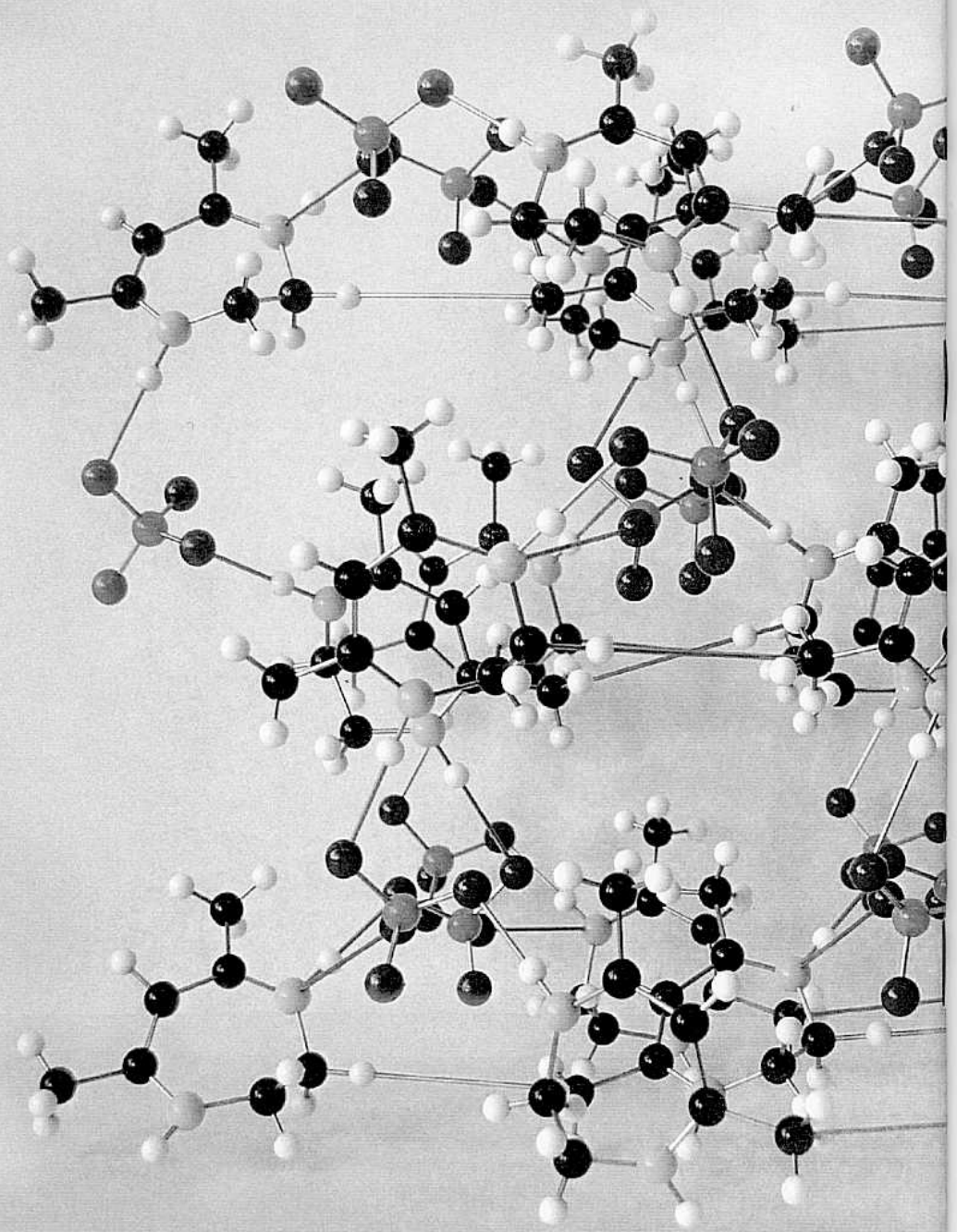

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