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A Brief History of Rothamsted Experimental Station from 1843 to 1901

Founded by John Bennet Lawes with Dr J H Gilbert

By Margaret Holden (1972)

Margaret Holden (1920-1998) was a founder-member of the Local History Society. A botanist and mycologist, she worked in the Biochemistry Department at Rothamsted from 1944 until her retirement in 1980. She wrote this paper on the origins of agricultural research at Rothamsted in 1972.



John Bennet Lawes, aged c.45 - mid 1850s
LHS archives - cat.no. HC 171

Harpenden's only real claim to fame is the presence of Rothamsted Experimental Station, which is the oldest agricultural research station in the world. The Rothamsted experiments were started by John Bennet Lawes who was the squire of the manor. He was born at Rothamsted Manor on 28 December 1814. He was descended partly through the female line from that interesting character [Sir John Wittewronge](#) who lived at Rothamsted in the 17th Century. His father, also called John Bennet Lawes, died when he was only eight and his mother (Marianne) was responsible for bringing him up. He went to Eton and then on to Brasenose College, Oxford, but left without taking a degree. He seems to have been interested in chemistry from an early age and while at Oxford attended some lectures on chemistry. But he reckoned he had not learnt anything from them and wished he had gone to Cambridge where he could at least have learned some mathematics.

At the age of 20 in 1834 he took on the management of the Rothamsted home farm, which was then about 250 acres. The estate was in debt because his father had had the doubtful honour of being a friend of the Prince Regent. In addition, the country was still suffering from the poverty brought about by the protracted Napoleonic Wars. But it was a time of considerable activity and great efforts were being made by many people to improve the land and methods of cultivation. Large areas were being tile-drained and made fit for growing arable crops and poor sandy soils were being improved by marling and claying. All sorts of materials were being used as fertilizers.

The first experiments



One of the best bedrooms at Rothamsted Manor - c 1890? - not the first laboratory.

LHS archives - cat.no. HC 104

At the same time as starting to manage the farm he embarked enthusiastically on his chemical investigations. He upset his mother by having a laboratory set up in one of the best bedrooms of the manor. At first he studied the active principles of a number of drugs and grew all sorts of plants such as hemlock, colchicum and opium poppies from which to extract the drugs. The lab in his bedroom soon became too small for him and he transferred his work to an old barn. By this time he had become interested in applying chemistry to agriculture and in the late 1830s he started experiments, first on plants in pots and then on a field scale, on the effects of various chemical substances on plant growth.

One of the things he tried was ground bones treated with sulphuric acid to make the phosphate in them soluble in water. This was an effective manure, but bones were expensive and in short supply. However, mineral calcium phosphate was becoming available fairly cheaply, and Lawes treated mineral phosphates with sulphuric acid and found this material was as good as acid-treated bones. It was particularly effective for turnips because it speeded up the development of the seedlings and took them quickly through the stage at which they were most likely to be irreparably damaged by flea beetle.

Founder of the fertilizer industry

In 1842 Lawes took out a patent for the manufacture of superphosphate, as the acid-treated calcium phosphate was called, and in the following year set up a factory at Deptford to produce it. He thereby founded the vast artificial fertilizer industry and the annual world output of superphosphate alone now runs to many millions of tons. The fertilizer business prospered and soon a much larger factory was erected at Barking Creek. Lawes maintained his interest in the fertilizer business for about 30 years and then sold it for £300,000. The Lawes Chemical Company went bankrupt only a few months ago.

Lawes had other business interests as well and owned a factory that made tartaric and citric acids – this he kept until the end of his life. He also had a sugar estate in Queensland, but this was not a profitable venture because the price of sugar was low and there was no cheap labour available to run the estate.

Start of collaboration with Dr J H Gilbert - 1843

After taking out his patent, Lawes divided his time between the business in London as a chemical manufacturer and agricultural research at Rothamsted. The experiments soon reached the stage when it became necessary to have the assistance of a trained chemist. At first he had help from a Mr Dobson for a short period and then in June 1843 Dr J H Gilbert started work at Rothamsted. The Station is deemed to have been founded from the time of Gilbert's arrival. The collaboration between Lawes and Gilbert was to continue for 57 years – this is by far the longest scientific partnership known. It was a remarkably fruitful partnership, largely because the two men had temperaments that were complementary. Lawes was full of ideas as well as being a real practical farmer, but he had neither the time nor patience for doing detailed scientific work. Gilbert, in contrast, was as interested in the tedious routine work involved in getting the results as in the results themselves.

From the start Lawes and Gilbert aimed to find out how plants feed. They soon got embroiled in a somewhat bitter and prolonged controversy with Liebig, a distinguished German agricultural chemist, with whom Gilbert had studied before coming to Rothamsted. Liebig maintained that plants obtain all the nitrogen they needed from ammonia in the air and that it

was therefore unnecessary to apply nitrogen-containing manures. Lawes, from his farming experience, was convinced Liebig was wrong and with Gilbert laid down a series of field experiments to obtain proof of the necessity for nitrogen from the soil. In these they measured the effect on the yield of various crops of supplying mineral salts containing the elements found in plant ash, with or without nitrogen-containing salts. Mostly the crops were grown continuously on the same land which received the same fertilizer treatment year after year, but there was one experiment in which crops were grown in rotation as in normal farming practice. After a few years the value of nitrogenous fertilizers for the crops being tested was proved beyond any reasonable doubt.

The wheat experiment on Broadbalk was started in 1843 and so was an experiment with root crops on Barnfield. These are the earliest of what are now known as the **Classical Experiments**. Others followed during the next 15 years, notably the barley experiment on Hoosfield (1852) and the hay experiment on Park Grass (1856). Altogether over 40 acres were laid down to experiments. Except for the root-crop experiment on Barnfield which was abandoned several years ago [1960], the experiments have continued to this day in something like the form they were laid down so long ago. For many years they were practically sacred and they were almost unaltered until quite recently when some major modifications were introduced so that additional information could be got out of them.

Family and staff

In the 1851 census return Lawes is simply described as a Gentleman, whereas in 1861 he is called a landed proprietor occupying a farm of 450 acres, employing 22 men and 17 boys engaged in scientific agriculture and manufacture of artificial manures. [Lawes married in 1842](#) and at the time of the 1851 census his two children Charles and Caroline were quite young, so a nurse is among the household of 13 servants. She is replaced by a governess in the 1861 census. By then there were 15 servants. On each occasion the household included a lady's maid, laundrymaid, kitchen maid and dairymaid. In 1851 there were a cook and a housekeeper but in 1861 only a cook-housekeeper. But instead of one housemaid there were two and in addition there was a scullerymaid and a poultrywoman. Among the five manservants in both 1851 and 1861 were a bailiff and a footman. A groom in 1851 is replaced by a coachman in 1861.

One of the outdoor servants in 1851 was described as vermin destroyer. Among the household in 1861 is Robert Dudgeon who is described as 'assistant laboratory'. His name was not included among former members of the staff by Sir Daniel Hall in his account of the Rothamsted Experiments. However, Edwin Grey in his *Rothamsted Reminiscences* tells something about him. In spite of the census description as a laboratory assistant he in fact never worked in the lab. He was a Scotsman (born at Haddington) and a jack-of-all-trades being a steward at the Manor, supervisor of the experimental plots and the first secretary of the Rothamsted Allotment Club. He had a mental breakdown and spent several years in an institution. When he recovered he set up as a travelling seedsman in this area and used to visit the lab to use one of the balances for weighing out his seed into packets. The lab men and allotment holders all used to buy their seeds from him and he seems to have been a popular character.

The Testimonial Laboratory



The Lawes Testimonial Laboratory - c.1862

LHS archives - cat.no. B.2.101

Already by 1853 farmers in Hertfordshire thought very highly of the work being done at Rothamsted and decided to present Lawes with a testimonial. The collection was at first a local one, but was later widened to become national and nearly £1200 was collected. Most of the money was spent on building a new laboratory and this was opened with due pomp and

ceremony in 1855. At the opening ceremony Lawes declared 'that the object of these investigations is not exactly to put money into my pocket, but to give you the knowledge by which you may be able to put money into yours'.



Interior of Testimonial Laboratory - c.1862

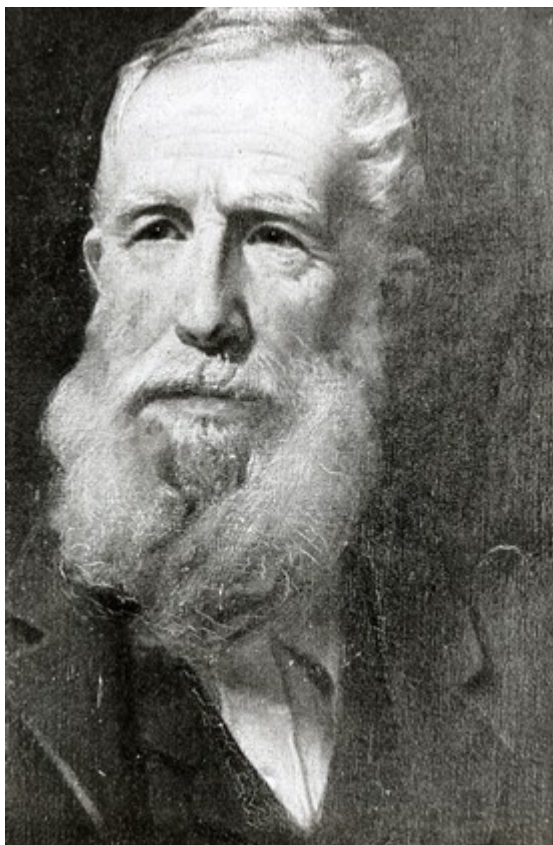
Copy in LHS archives: cat.no. B2.102

Among the records in the Rothamsted file in the Harpenden Urban District Council office there are two hand-written drafts of the specifications for fitting out this laboratory. The Lawes Testimonial Laboratory no longer exists and I was not sure of its exact site until I saw a photograph in the UDC office that was taken just before the First World War. This shows the Lawes Testimonial Lab still there and the right-hand end (viewed from the Common) of the present laboratory building. The two bits were joined by a small building called the Mason Laboratory which was set back from the other two blocks. The Mason Lab was incorporated in the back of the present building and nowadays houses several of the lab offices (though it was still laboratories when I first came to Rothamsted in 1944).

Lawes was made a Fellow of the Royal Society in 1854 and he and Gilbert were awarded a Royal Medal by the Royal Society in 1867 for their work on agricultural chemistry. Several of their papers were published in the *Philosophical Transactions* of the RS, but most of the reports of the Rothamsted field experiments were published in the Journal of the Royal Agricultural Society. Lawes was closely connected with the Royal Agricultural Society almost from the time it was founded in 1838. He took an active part in arranging the start in 1876 of field experiments sponsored by the Society at Woburn. These experiments were on part of the Duke of Bedford's estate and the then Duke paid for them. Some of the Rothamsted experiments were repeated there because of the great contrast between the sandy soil of Woburn and the heavy clay-with-flints of Harpenden. Fifty years later Woburn Experimental Station became part of Rothamsted and continues to be to this day. Lawes was also a Fellow of the Chemical Society and many papers on the chemical side of the work done by Gilbert in the lab at Rothamsted were published in the Journal of the Chemical Society.

Lawes was called in whenever there was some agricultural problem to be enquired into. Rather interestingly in the light of the interest being taken into pollution at the present moment, a Royal Commission was appointed in 1857 to enquire into the best method of distributing the sewage of towns and applying it to beneficial and profitable uses. Lawes was a member of this commission and an experiment was carried out at Rugby in 1861-64. Gilbert and others at Rothamsted were responsible for looking after it. Lawes and his wife were conservation minded long before it became the popular thing and would not have the hedges trimmed near the Manor so that birds could nest and roost in them.

Gilbert apparently did most of the actual writing up of the scientific papers but Lawes wrote a great many semi-popular articles on agricultural subjects for newspapers and periodicals, and he was very good at explaining things in non-technical language.



Sir John Bennet Lawes, 1890s

LHS archives - cat.no. B 3.73

Lawes was created a Baronet in 1882, various honorary degrees were bestowed on him, and gold medals were awarded to him by the Russian and German governments. The Lawes Agricultural Trust was set up in 1889 with an endowment of £100,000, the interest to be applied to the maintenance of agricultural investigations. The Trust was given the use of the fields at a peppercorn rent. Nowadays (1972) most of the Rothamsted income comes from the government but the Lawes Trust still exists and is in fact the governing body of the Institute, thus preventing the staff from actually being civil servants.

Golden Jubilee in 1893



The Testimonial Laboratory in 1906/7 - the marquee probably erected for the opening of the James Mason Laboratory, which is on the right, partly obscured.

LHS archives - cat.no. B 2.103

In 1893 the golden jubilee of the Rothamsted experiment was celebrated. It was at this time that the large boulder of Shap granite was erected in front of the lab. It must have been more or less centrally placed in front of the Lawes Testimonial Laboratory. There was a presentation to Sir John Lawes of his portrait by Herkomer and Gilbert received a silver salver. There were addresses from the Royal Society and other scientific societies both British and foreign. It must have been a rather emotional occasion judging from the speech made by Lawes about his fifty year collaboration with Gilbert. An anthem was specially composed for the occasion by C B Kaye, who had worked at the lab as a clerk some years previously, and was the organist at the parish church. This anthem 'All thy works praise thee' was dedicated to Lawes and Gilbert. The solo

part 'He maketh peace in thy borders and filleth thee with the flour of wheat' was taken as referring to the famous Broadbalk wheat field.



Sir Henry Gilbert - c.1890s

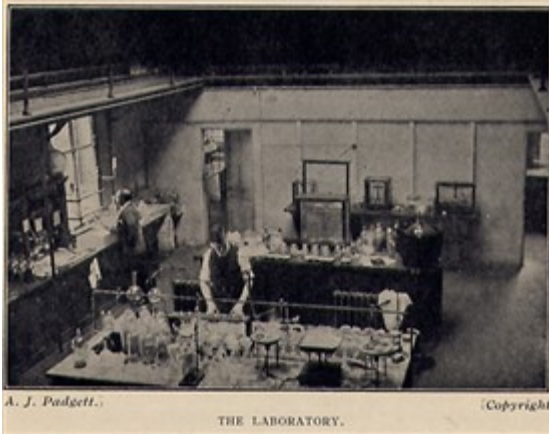
Copy, courtesy of St Albans Museum of a photo by A J Melhuish, Pall Mall - LHS archives 001027

Gilbert was knighted about this time and the two of them, appropriately enough after their controversy with Liebig fifty years earlier, awarded the Liebig Silver Medal of the Royal Bavarian Academy of Sciences. Gilbert was not the genius that Lawes was but he was a truly remarkable man in his own way and the Rothamsted experiments would not have got very far without him. He was extremely methodical and acquired masses of results before coming to a conclusion, but when he finally did reach one he stuck to it against all arguments to the contrary. When he had worked out a good method for determining a particular component of plant or soil he went on using the method for years without altering it; thus long series of results are absolutely comparable. He kept samples of all the crops and soils from the various plots, so that if necessary results of determinations on them could be checked. When he died there were over 50,000 samples, many of them stored in the sample house, a building just behind the main lab. Today the sample house is an annexe of the library and samples are stored in outbuildings at the Manor.

Gilbert's great aim was to make a complete balance sheet for the nitrogen in the crop, in the soil, in the drainage water from the soil and in the rainwater falling on soil and crop. To help with this, large rain gauges and drainage beds were therefore constructed and weather records carefully kept. Rainfall measurements were started almost 120 years ago, temperature and barometric pressure in 1873 and sunshine records in 1891. Rothamsted has been for many years an accredited weather station for the Meteorological Office – the drainage beds are still draining and the 1/1000 acre rain gauge is still in use. Three hundred years ago Sir John Wittewronge kept an account for several years of the weather every single day of the year at Rothamsted. I think he would like to know that the weather records are still being faithfully kept at Rothamsted.

Gilbert had very poor eyesight as the result of an accident with a gun when he was a boy and he had to rely on his wife to read and translate scientific papers to him, and his own papers had to be dictated to a clerk. Nevertheless he was an active man and frequently attended scientific meetings and was on the committees of scientific societies. He also established the custom, followed enthusiastically by Rothamsted staff ever since, of visiting at every possible opportunity labs and experimental stations in Europe and America. He lectured a great deal and for six years was Sibthorpe Professor of Rural Economy at Oxford. This was no sinecure as during that time he gave over 70 lectures on the results of the Rothamsted experiments.

Working at Rothamsted - Edwin Grey's *Reminiscences*



Interior of the Laboratory, 1900s

A J Padgett, reproduced from 'Our Land', Vol.II, No. 18, July 1909



Comparative results of wheat growth, 1900s

A J Padgett, reproduced from 'Our Land', Vol.II, No. 18, July 1909

It is unnecessary to go into detail about what it was actually like to work at Rothamsted during the last quarter of the 19th century. This has been marvellously described by Edwin Grey in his *Reminiscences, Tales and Anecdotes of the Laboratories, Staff and Experimental Fields*. However, a few of the men who spent so many years of their lives in the service of Rothamsted must be mentioned. Edwin Grey first worked at Rothamsted in 1872 as a boy of 13. He helped sort the grasses and other plants from the hay samples of the Park Grass experiment. He then went back to school for a few months, spent a year at Field's hat factory (later Abbotts waterproofing factory) and was sent for by Gilbert in November 1874 when a vacancy occurred at the lab. He was still listed as a member of the staff in 1938 and he died in 1955. G. Gifkins spent 41 years at the lab as Clerk (1852 - 1893). He was a well-educated man and before going to Rothamsted had run a school in Leyton Road. He was the clerk who used to help Gilbert with his work in the evenings. G. Knott was a chemical assistant for 33 years (1858 - 1891) and J. J. Willis was a botanical and general assistant for 49 years (1862 - 1911). H. King (who had been Lawes' servant when he was a student at Oxford) was caretaker and general assistant for 36 years, starting in 1843. He was followed by C. Bigg from 1879 to 1910. G.T. Dunkley was the Secretary from 1878 to 1917. Of the farm workers there seem to be records of rather few but Frank Freeman and his son Alfred are noteworthy. The father was in on the experiments from the beginning in 1843 and although he was not educated he was wonderfully good at looking after the plots. He worked until his death in 1900. Alfred had started on the farm in 1875 and took over from his father, whom he outlived by only 15 years.

The last important work done in the time of Lawes and Gilbert was carried out by Robert Warington, who worked at Rothamsted from 1876 until 1890 when he was appointed Professor of Chemistry at Oxford. It was known that ammonia supplied as fertilizer was quickly converted into nitrate, but at that time it was not known how it occurred. However, in 1877 two French chemists showed that nitrate formation during sewage purification was brought about by bacteria (these had only comparatively recently been described by Pasteur). Warington showed that bacteria in the soil were responsible for nitrates being formed and, in fact, found out that the reaction proceeded in two stages, nitrite being formed first and then nitrate. His experiments showed clearly that two different organisms were involved, although he was unable to get pure cultures of them. He also studied the process of identification whereby other bacteria break down nitrate with nitrogen gas being evolved. Warington's daughter Katherine worked in the Botany Department at Rothamsted from 1921 to 1957 and her main contribution to knowledge was the discovery of Boron as an essential plant nutrient.

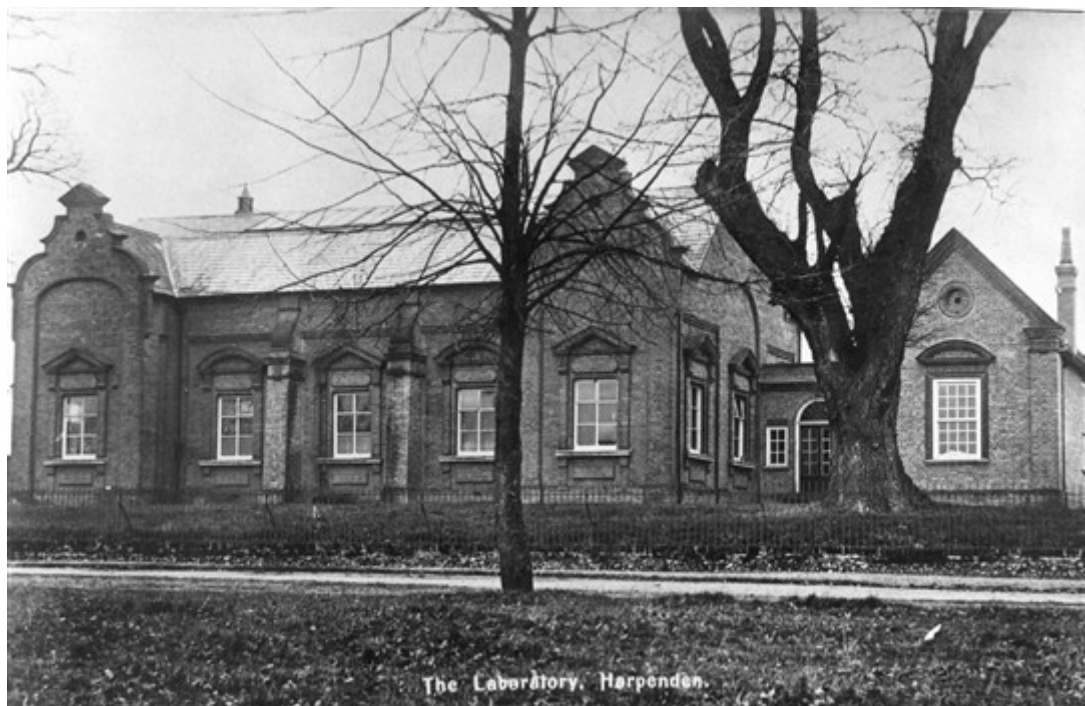


Impressive memorial to Sir Henry Gilbert in St Nicholas churchyard
Rosemary Ross, April 2014

During the later years of the 19th century both Lawes and Gilbert were getting very old and although the field experiments and the lab work connected with them continued unabated no new lines of work were started – the first chapter, and it was a very long one, was nearly finished.

It closed just at the turn of the century with Sir John Lawes dying in 1900 at the age of 85 and Sir Henry Gilbert dying in 1901 at 84.

They are buried close together in the churchyard of the parish church.



The Testimonial Laboratory and James Mason Laboratory, taken between 1909 and 1914. Buttresses were added to the Testimonial Laboratory to stabilise it in 1909

LHS archives - cat.no. HC 011

More information available in the Rothamsted Archives-

<http://www.rothamsted.ac.uk/Content/Library/ArchiveDocuments/ArchivesCatalogue.pdf>

This page was added by [Rosemary Ross](#) on 06/04/2014.

Comments about this page

Captions to the photographs of the Testimonial Laboratory and the James Mason Laboratory have been amended, following careful scrutiny by Rothamsted archivists. The James Mason Laboratory was opened in 1906/7 and the marquee probably relates to an opening ceremony - not to the Jubilee celebrations of 1893 as previously thought. In 1909 the Testimonial Laboratory was strengthened with buttresses. However, in 1914 the crumbling old building was pulled down and replaced by the southern extension of the North Wing, to form the current facade of the Russell building, completed by 1918, and formally opened in 1919, as described by [Professor Roger Plumb](#) in his talk to the Rothamsted Association in November 2013.

By Rosemary Ross

On 21/06/2016

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