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ROTHAMSTED  
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# Rothamsted Research Annual Report 2002-2003

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## Director's Introduction and Review of the Year

### Rothamsted Research

Rothamsted Research (2003) *Director's Introduction and Review of the Year* ; Rothamsted Research Annual Report 2002-2003, pp 4 - 9



The newly restructured institute was showcased to funders and stakeholders at the Royal Society on 20th January

## DIRECTOR'S INTRODUCTION

### Rothamsted Research: a view of the future

#### 2003 – a new laboratory and a new name

During 2002, I announced that the former Institute of Arable Crops Research would cease to exist as an entity and the name of our restructured organisation would be Rothamsted Research (formally abbreviated to RRes). Our new name conveys continuity with a past of which we are justly proud but also signals a landmark in the process of significant change on which we embarked over four years ago. Early in 2003, we “launched” Rothamsted Research during a successful event for our many stakeholders at the Royal Society in London.

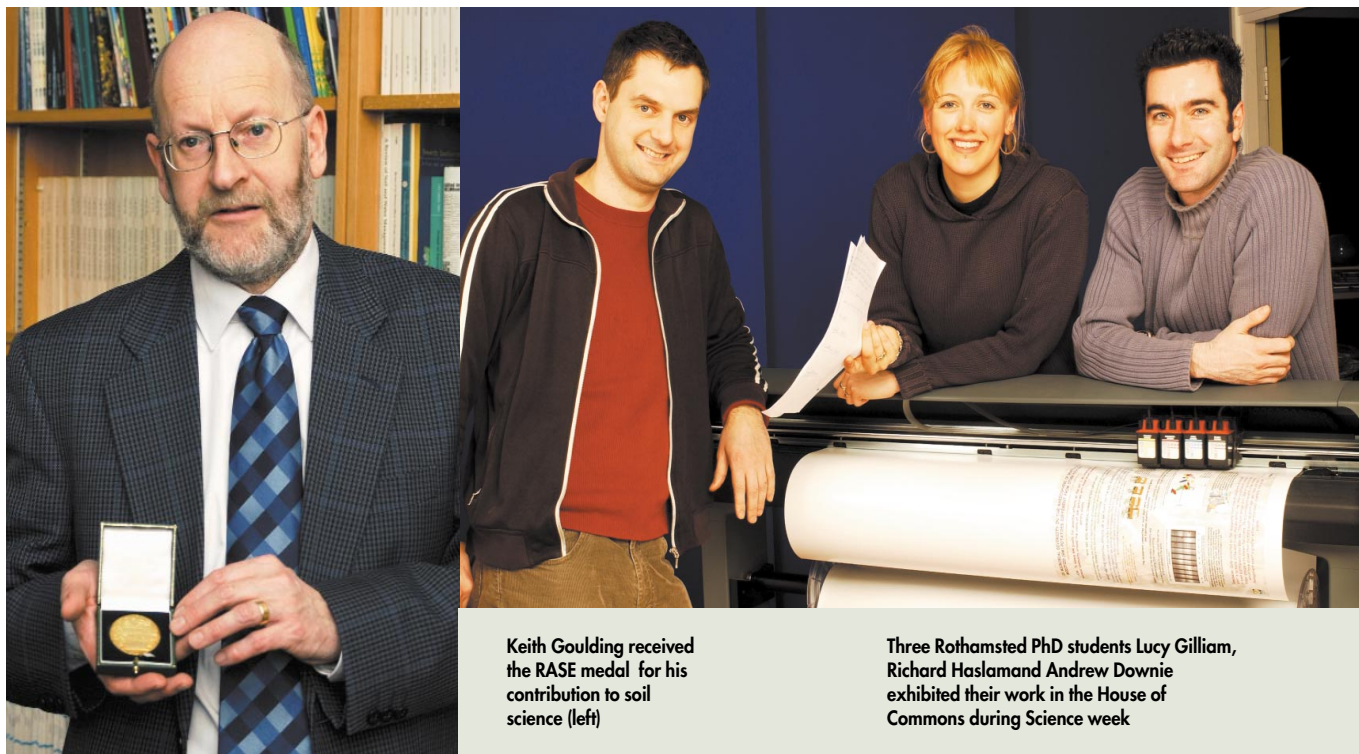
The plan to amalgamate the research conducted at Long Ashton Research

Station and Rothamsted Experimental Station was announced during 1999 and by May 2003 the transfer of more than 50 scientific staff from Long Ashton to Rothamsted will have been completed as will the occupancy of a spectacular new laboratory at Rothamsted. This new laboratory enables the close integration that modern multidisciplinary science demands and collocates those transferring from Long Ashton with colleagues moving from laboratories at Rothamsted which are no longer fit for purpose. The outcome is that all our work in plant, invertebrate and microbial biomolecular sciences will be housed together in state of the art facilities backed by excellent glasshouse, insect rearing, controlled environment, analytical chemistry and biological imaging capability. This

development is a tangible manifestation of an enduring partnership between RRes, the Lawes Agricultural Trust, who own the Rothamsted site, and the BBSRC.

The Board of Directors of RRes have named the new laboratory the “Centenary Building” to mark the fact that 2003 coincides with 100 years of scientific research at Long Ashton (appropriately chronicled in a recent publication entitled: “Long Ashton Research Station: one hundred years of science in support of agriculture” edited by Anderson, Lenton and Shewry). The period of planning and construction of the Centenary Building also coincided with the centenary of the death of Rothamsted’s founding fathers: Sir John Lawes and Sir Henry Gilbert.





Keith Goulding received the RASE medal for his contribution to soil science (left)

Three Rothamsted PhD students Lucy Gilliam, Richard Haslam and Andrew Downie exhibited their work in the House of Commons during Science week

### Rothamsted Research – meeting the challenges of sustainable development

Agriculture and food production provide one of the most spectacular illustrations of the benefit that the acquisition of scientific knowledge can have on the well being of mankind. Just a few generations ago there was no part of the globe that was free from deprivation resulting from unpredictable food supply. Thanks to the application of science, we are, in Europe at least, confident of a predictable supply of sufficient, good quality, affordable food and Rothamsted has been centre-stage in this endeavour. However, today's context for land management in northern Europe is set by the inevitable expansion of the European Union, the globalisation of world trade, the expectations of an increasingly prosperous population, the strengthening green agenda and the increasing economic value accorded to land for purposes other than food production. Nevertheless, we should not forget that over 840 million people are undernourished and the population of the globe is set to rise from 6 billion to 9 billion by 2050. In the next 50 years, the world must produce at least 75% more food than it does at present

to sustain the projected increase in population. We must reconcile the scientific agenda that is influenced by land management strategies in Europe with the requirements for land and food of the world's disadvantaged populations.

Science that provides an understanding and delivery of more sustainable production systems unifies what at first sight might seem disparate requirements of primary producers in the developed and developing world. Simply put, there is only one agenda. This agenda is for new knowledge, translated into new technology, to enable greater required productivity per unit area of land, in parallel with reductions in non-renewable inputs. The value that is placed on land for purposes other than food production, whether in Europe or elsewhere, means that there is no sound argument for cultivating more land than is absolutely necessary. This is regardless of whether the reason is to conserve the functional or aesthetic value of natural habitat or to create sought after man-made amenity. To avoid the requirement for more land to be devoted to food production there is a need for an intensification of science-based management as a means of achieving reductions in non-renewable inputs.

The classical Broadbalk winter wheat experiment at Rothamsted has generated data since 1843 and mirrors production in the UK. For about 100 years, yields from continuous wheat cultivation on plots receiving no inputs were between 1 and 1.5 tonnes per hectare. Over this same period it was clearly demonstrated that yields could be predictably doubled with inputs of farmyard manure or mineral fertilisers. Yields took-off in the 1960s with the introduction of semi-dwarf varieties, the

#### Box 1:

##### Ten attributes that define sustainable systems of land management

- substantially dependent on renewable inputs
- predictable output over many generations
- non-polluting
- profitable and socially acceptable
- conserves functional and aesthetic biodiversity
- conserves valued landscapes
- maximises resource use efficiency
- does not transfer problems elsewhere
- adverse changes are readily reversible
- responsive to changing requirements and constraints (e.g. population and climate)



'Chasing the High Flyers' exhibit on vertical radar studies was selected for the Royal Society summer science exhibition. It was also featured at the Tomorrow's World Roadshow and the Science museum

Box 2:

**Drivers for science in support of sustainable management of agricultural land**

- reduced reliance on fossil carbon inputs
- effective nutrient recycling (especially N, P and K)
- durable pest, disease and weed control less reliant on chemical synthesis
- characterisation and conservation of functional biodiversity
- crop genetic improvement for resource use efficiency
- definition and conservation of soil quality
- minimisation of diffuse pollution (air, water and soil)
- crops as "factories" and fossil carbon substitutes

deployment of genetic disease resistance, and the judicious use of herbicides, fungicides and insecticides. As a consequence of these advances, crops yielding 10 tonnes per hectare can be regularly achieved. These remarkable levels of output have been achieved for just one generation, and it is important to know whether they can be sustained indefinitely.

Sustainability means different things to different people and there are those who conclude the concept has generated more conflict than consensus. However, within RRes we have recently identified ten attributes that define sustainable systems (Box 1) along with the key drivers that provide the rationale for RRes science in support of sustainable land management and rural economies (Box 2). It is evident that some of the inputs that drive today's level of output are not truly sustainable. Agriculture is heavily dependent on fossil carbon inputs; pathogens evolve to overcome genes for resistance; weeds, pathogenic fungi and insects evolve resistance to agrochemicals. There are also legitimate questions about the economic and environmental impact of modern agricultural practice such as fertiliser usage. With a view to future generations, there is an urgent

need for new, substitute technologies founded on sound science, that will in time replace inputs dependent on non-renewable resources.



As part of the Golden Jubilee celebrations we hosted the Jubilee Science Walk around the Rothamsted estate, attracting around 300 people



### **Sustainable agriculture and the promise of integrative biology**

At the start of the 21st century, there is a burgeoning of knowledge about how biological systems work. This explosion of information is being catalysed by both access to whole genome DNA sequences and a new productive synergy between the biological, physical and mathematical sciences. There is therefore a real cause for optimism that new products and practices will emerge from the knowledge-based revolution in the biosciences. This provides the backdrop for the BBSRC's recently published "Bioscience for Society - Ten-Year Vision: towards predictive biology" and its Strategic Plan to 2008: "World Class Bioscience".

The RRes research strategy reflects the BBSRC's commitment to research for sustainable agriculture and is closely aligned with the report from the Policy Commission on the Future of Farming and Food (Curry Commission) and

Defra's response to it. The scientific and technological progress required to achieve more sustainable systems of land management is underpinned by a focus within both RRes and the BBSRC on the concept of integrative biology and the vision of a more predictive understanding than is possible at present.

The central importance of whole organism biology and the complex of interactions between organisms, is a hallmark of RRes science. However, to understand the biology of whole organisms requires integration of knowledge from the level of cells and molecules that draws on chemistry, genetics, biochemistry and molecular biology. The development of verifiable predictions based on large data sets and formalised in mathematical models is a feature of RRes science. One outcome consistently sought from RRes research is more accurate prediction about how complex systems behave and how best they can be managed for benefit.

In the context of integrative biology of relevance to sustainable agriculture, the scientific community now has access to the whole genomic sequence of several relevant organisms and the stage is set for knowledge derived from these data to play a significant part in achieving greater sustainability of agricultural systems. It is through knowledge from integrative biology that technologies will emerge that can substitute for present ones that are acknowledged as being unsustainable in the long term.

The future emphasis of RRes over the next decade will be the introduction of new sustainable practices based on high quality ecological and environmental sciences along with new sustainable products based on high quality biomolecular sciences. Our objective will be to contribute significantly to the implementation of "Best Practice".

RRes will be striving hard to understand and meet the changing requirements of its end user communities. The



Alastair McCartney receiving an honorary professorship from Professor Cheng Jian, President of the Anhui Academy of Agricultural Sciences, China. He also accepted an honorary professorship on behalf of Bruce Fitt. The awards recognised collaborative research between the Plant Pathogen Interactions Division and Anhui Academy of Agricultural Science

Rothamsted science was explained in cartoon format with help from a BBSRC grant. The cartoons were distributed free to schools and featured in BBC wildlife magazine

Rothamsted Research Association (formerly the Arable Research Institute Association) provides a vehicle for an active dialogue with the UK land management sector. Similarly, Rothamsted International enables our engagement with the International Development agenda. We expect to meet the needs of the EU and Defra in the formulation and implementation of policies of relevance to agriculture and land management and we expect our work to impact on both the production and supply sides of the food and non-food chains. In the context of sustainable development, RRes has a key strategic role to play in the coming years. We take this responsibility seriously as society confronts some enormous national and international challenges. Not all answers lie with science but, as in the past, science has a large part to play in achieving benefit and security for future generations. We have more opportunity now than ever before to harness biological knowledge for widespread benefit.

