Chair in Crop Genetics & Phenotype Biology
Institute of Biological Environmental and Rural Sciences
Salary will be made within the Professorial Range

As part of its ongoing development IBERS is seeking to appoint a Research Chair in Crop Genetics & Phenotype Biology. A major element of IBERS research strategy is the establishment of a Plant Phenomics Centre affording automated, high throughput (HT) imaging for quantitative assessment of agronomically relevant plant traits. The successful applicant will have a track record in the use of forward genetics approaches for positional cloning in crops. A key responsibility will be to increase research grant capture, and the successful applicant will lead research work focused on the cloning of key genes controlling complex traits in crops, and will be responsible for co-ordinating linkage between genotyping and phenotyping activities in IBERS. Individuals with a core interest in a biological problem of agricultural relevance that can be approached by new methods of non-invasive image analysis, data processing and predictive modelling in a biological context are encouraged to apply. The post is funded by the Biosciences, Environment and Agriculture Alliance (BEAA), which is a strategic partnership between Aberystwyth and Bangor Universities and the Biotechnology and Biological Science Research Council (BBSRC). Funding for BEAA was provided by Aberystwyth and Bangor Universities, BBSRC, and HEFCW, with a total budget of £55m.

For further details on IBERS genomics activities contact Professor Wayne Powell (wap@aber.ac.uk) and for information on the Plant Phenomics Centre contact Professor John Draper (jhd@aber.ac.uk)

Applications should include 8 copies of a covering letter, application form (a link to which can be found directly below the advert) and a full CV containing the names and addresses of three referees. Applicants from overseas may submit one copy.

Ref: IBERS.10.20
Closing Date: 14 September 2010
Interview Date: During the second half of October 2010

NOTE: Please put the post reference on the front of your envelope and on your application form.

Completed Applications Forms should be signed and returned to the **Human Resources Recruitment Team** by fax or post.

Bilingual Institution which operates a Welsh Language scheme.
Committed to Equal Opportunities.

Operations Team: vacancies@aber.ac.uk / Tel: 01970 621591 / Fax: 01970 622975
For information and application forms please go to www.aber.ac.uk/hr

PLEASE NOTE THAT YOUR APPLICATION WILL ONLY BE ACKNOWLEDGED IF YOU PROVIDE A STAMPED ADDRESSED ENVELOPE. APPOINTMENTS ARE NORMALLY MADE WITHIN 4-6 WEEKS OF THE CLOSING DATE. IF YOU DO NOT RECEIVE A COMMUNICATION FROM THE UNIVERSITY BY THAT DATE YOU MAY ASSUME THAT YOUR APPLICATION IS NOT BEING FURTHER CONSIDERED AND NO OTHER COMMUNICATION WILL BE SENT.

Further Particulars

Aberystwyth University has a long and distinguished history of teaching and research in the fields of biology, agriculture and related disciplines. Established in 1872 as the University College of Wales Aberystwyth, the University has had a major global impact on agriculture, particularly upland and pastoral farming. The establishment of the Welsh Plant Breeding Station (WPBS) in 1919 made Aberystwyth a global force in the development of grasses and

clovers for temperate upland agriculture. This tradition continues today with the formation in April 2008 of the Institute of Biological, Environmental and Rural Sciences (IBERS) from the fusion of the University Institutes of Biological Sciences and Rural Sciences with the former BBSRC funded Institute of Grassland and Environmental Research.

IBERS is also part of BEAA, a strategic partnership with Bangor University College of Natural Sciences (CNS). It is the largest multi-disciplinary bio-environmental grouping in the UK, and was created to provide internationally competitive strategic research and development capacity in Wales to address 21st century environmental challenges.

Agriculture will be important for providing solutions to key global challenges over the next fifty years, including the delivery of food, water and energy security. IBERS has expertise in crop genetics and genomics, with an emphasis on perennial out-breeders, that is recognised worldwide and attracts substantial Research Council income. Fundamental research underpins commercially successful breeding programmes for forage grasses, legumes and oats, together with a range of novel breeding related activities in other crops, including the energy grass *Miscanthus*. Breeding programmes are complemented by considerable expertise in high throughput phenotyping, currently focused on metabolomics and high dimensional data modelling, which aim to link genotype to complex traits in model species (*Arabidopsis* and *Brachypodium*), in crops and in plant-pathogen interactions.

IBERS employs >300 staff, has an annual turnover of £25 million and represents the largest land-based science department in the UK. There is an active programme of £10.3 million infrastructure investment in existing and new core facilities to support genomics, metabolomics and phenomics. The Translational Genomics Centre, currently under construction, will provide a focus for Next Generation Sequencing activities (including 454 and Illumina). The Metabolomics Centre is equipped with a range of robust, high mass accuracy and high sensitivity instruments supporting metabolite fingerprinting, metabolite profiling and targeted analysis including Orbitrap, FT-ICR-MS, GC-tof-MS and Triple Quad technology. The establishment of the Plant Phenomics Centre (see below) expands the Institutes' already expansive capacity to provide controlled environment facilities for plant growth and trait analysis.

The 'data-rich' nature of modern biology demands closer collaboration between biologists, mathematicians and bioinformatics experts. IBERS will ensure that it is positioned to fully exploit emerging research opportunities through the coordinated establishment of a **Chair in Bioinformatics** and a research **Lectureship in Bioinformatics** (*New Generation Sequencing*) together with a **Chair in Crop Genetics and Phenotype Biology,** collectively specialising in developing an informatics infrastructure for Phenomics Biology. To complement these posts, related research **Lectureships** will be established within the same time frame from **three** of the following areas: **Statistical Genomics, Quantitative Genetics**, **Metabolomics**, and **Epigenetics**.

It is intended that these posts will strengthen linkages with the Department of Computer Science in areas of Computational Biology and particularly phenotype ontology development from automated non-invasive image analysis. A key mission of IBERS is to promote the integration of Phenomics, Metabololomics and Translational Genomics to support new generation crop plant and animal breeding programmes. A key component of this activity involves development of external collaborations with world-class systems biology centres. Wherever possible, this systems approach will be extended to landscape/spatial analysis with high dimension, large volume datasets now available from earth observation and environmental instrumentation in collaboration with Institute of Geography and Earth Sciences within AU.

In addition to new staff appointments, to achieve our goal of integrated science IBERS will create a new, computing facility that will be shared by scientists across IBERS computer-intensive research areas. The increased potential for cross-fertilisation, mutual support and novel insights is an important driver for this strategic development, as well as the capacity for

processing very large datasets. The computing facility will be an open space of computer workstations, with spin out rooms. A high performance cluster will be available for modest parallel computing, along with data servers, 10^2 terrabyte storage and tape backup.

The Aberystwyth Plant Phenomics Centre

Functionality: The aim of the Centre will be to facilitate a step-change in plant phenotype measurement so that comprehensive phenomic information can be recorded from large numbers of plants in months rather than years. This will place Phenomics on a similar high throughput basis to genomics and metabolomics. It will enable the screening of large numbers of plants, such as mapping, breeding and mutant populations and germplasm collections for features of plant growth and function. It will allow the application of experimental treatments such as water and nutrient stresses, and provide comprehensive assessment of the responses of individual genotypes. This will address the phenotyping bottleneck that currently exists and, combined with modern genomic tools, will provide a radical approach for gene discovery and crop improvement. It will form a focus for development of high quality multidisciplinary collaborations with international scientists having interests in genetics and functional genomics, ecology, genecology, crop improvement, climate change mitigation and adaptation, and global agriculture in an environmental context.

System overview: The core facility initially will be based around automated non-destructive image analysis using a Scanalyzer 3-D HTS system developed by LemnaTec. It comprises a conveyor based system delivering RFID-tagged plants automatically to state-of-the art imaging stations controlled by high capacity computing equipment. At any one time, many hundreds of individual plants or trays of plants can be established on the conveyor system running between independent glasshouse compartments and a central imaging unit. Movement within the greenhouses and to the imaging unit, and watering and nutrition of plants on the conveyor system, will be controlled individually by reference to the RFID tags and recorded by a central computer system that will also control acquisition of images. The system can be set up to record specific images at preset times during an experiment as the plants respond to, for example, drought or nutrient stresses, or to compare phenotypes during normal growth. A central advantage of the approach is that it is inherently non-destructive, allowing repeated measurements to be made on individual plants in a pre-programmed sequence through time with minimal operator intervention. Different treatments and imaging can also be provided on individuals or groups of plants within the system. The system is designed to cope with small plants such as forage grasses, forage legumes and *Arabidopsis*, and with larger plants such as oats, maize and *Miscanthus*.

Imaging: A number of imaging stations will be situated on the conveyor system:

1. **Visual imaging**: Comprehensive visible light imaging (employing cameras situated at the top and side and automatic turning of plants), designed primarily for measuring and recording morphology and growth of shoots. In addition visual imaging of roots grown in transparent columns (encased in a removable opaque outer pipe) will provide non-destructive assessment of root growth.

2. **Near Infra Red** (NIR/short wave IR): Comprehensive NIR / short wave-IR range imaging designed primarily for measuring water content of above ground shoots.

3. **Fluorescence**: Designed primarily for recording fluorescence from sources such as green fluorescence protein (GFP) and measuring chlorophyll fluorescence of shoots.

4. **Thermal infrared**: Comprehensive thermal imaging from top and several sides for estimating shoot temperatures, designed to detect water stress and stomatal response changes.

5. **Root NIR**: NIR imaging of roots and soil, designed to detect root growth and soil water content profile changes of plants grown in root columns (encased in a removable opaque outer pipe).

6. **Laser Scan**: A 3-D laser scan system which works from above to give accurate height and growth profiles of small plants such as forage grasses and Arabidopsis.

Flexibility will be built into the system to ensure that novel imaging methodologies can be incorporated as and when they are developed to ensure that the facility remains at the forefront of plant research internationally.

Ancillary equipment: The imaging equipment will be used to indicate the physiological state of plants and detect the impacts of environmental stresses such as constraints in terms of water, light, temperature and nutrients. As part of this process whole plant water use will be detected using two watering and weighing stations (one for watering, one for nutrient applications). These will allow flexible experimentation on a per plant basis by allowing slow or rapid drought, nutrient and water stress experiments. The nutrient addition station will enable precise application of individual nutrients. All actions of the weighing, watering and nutrient stations are controlled by the main database and can be defined in a precise and defined manner. This includes watering at programmed time intervals, watering to a constant weight or based on data acquired from image analysis such soil NIR measurement or detection of leaf rolling. Volumes delivered and weights measured are stored automatically in the database for future calculation *e.g.* evaporation rates or efficiency of water usage.

Image analyses and data storage and processing: Large volumes of objective quantitative data on plant phenotype will be produced with associated data on environmental variables including incident light, temperature and soil moisture. The system will be provided with appropriate computing power and software to:

1. Locate, carry out appropriate treatments and watering, move plants to and from the image acquisition units and initiate appropriate image acquisition.

2. Store all images collected in appropriate mass storage.

3. Provide appropriate databases to manage storage

4. Develop appropriate analyses with external collaborators of the images produced to provide relevant plant parameters.

5. Maintain appropriate records for QA purposes.

Links to other facilities and analyses available within IBERS

The plant phenomics facility will be closely linked to both chemical phenotyping and genotyping facilities in Aberystwyth. Plants will be delivered on the conveyor system to a work station where samples can be sampled destructively for DNA, RNA, Proteome or Metabolome analysis. An important component is the glasshouse complex ("the climate change facility") that will be part of the phenomics facility. This glasshouse will include compartments which will enable plants to be grown in carefully controlled conditions that will mimic those likely under potential climate change scenarios (*e.g.* elevated temperature, elevated CO_2). This glasshouse will provide a facility for analysing the effect of environment on the growth of a range of plant species and/or an experimental area where plants can be maintained prior to being loaded onto the scanning system.

International Links

The Aberystwyth Plant Phenomics facility will interact with an international consortium of laboratories intent of developing novel approaches to help close the genotype-phenotype gap and facilitate the identification and characterisation of many genes underlying important quantitative traits. It will provide the UK with a world class plants phenomics facility which will complement and link closely with the world-class UK genomics centre established at the John Innes Institute and with Plant Systems Biology Centres in Warwick and Nottingham Universities. It will also accelerate the selection of appropriate germplasm for breeding varieties which will perform robustly under the conditions predicted for the UK and beyond in the future. Furthermore, it will provide a focus for trans-disciplinary research to facilitate the discovery of the genetic and environmental bases for variation in complex traits that underpin

the major global challenges for food and energy security, water utilization and adaptation to a changing climate.

Job description

The post-holder will be expected to establish and lead an internationally significant research programme in the area of crop genetics and phenome biology. A key responsibility will be to increase research grant capture, and the successful applicant will have a track record in the use of forward genetics approaches for positional cloning in crops, will lead work focused on the cloning of key genes controlling complex traits in crops, and will be responsible for co-ordinating linkage between genotyping and phenotyping activities within IBERS. Individuals with a core interest in a biological problem of agricultural relevance that can be approached by new methods of non-invasive image analysis, data processing and predictive modelling in a biological context are encouraged to apply.

Since this is a research Chair, the post holder will have a primary role in leading research. However, the appointee may also be required to provide a limited amount of teaching within their own area of specialisation at both undergraduate and postgraduate levels.

Person Specification
Applicants will be assessed against the following criteria:

Essential criteria:

- A PhD (or equivalent) in a relevant discipline
- Internationally recognised achievement in original research;
- Recent, high quality publications in the area of genetic analysis of agronomic traits relevant to crop plants, and suitable for inclusion in the forthcoming REF (the successor to RAE);
- Track record in the use of forward genetic approaches for positional gene cloning in crop plants;
- Significant and sustained success in attracting external grant income to support research;
- Experience of the successful management of research programmes and/or research groups;
- Evidence of a strong commitment to collaborative, interdisciplinary research.

Desirable criteria

- Evidence of leadership qualities;
- Good knowledge of the research priorities of a range of stakeholders and funding bodies;
- Firm grasp of strategic priorities in an academic research environment;
- Ability to identify and meet training and career development needs of research team members;
- Invited presentations at international conferences, prizes, awards or other forms of external recognition
- Ability and willingness to contribute to the administration of the Institute, especially in research.