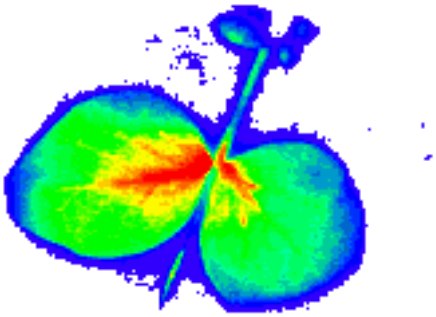
# Plant Cell Biology

Lund University, Sweden

http://plantcell.lu.se



Report for 1994-97

# Lund University

# Section of Plant Cell Biology, 1994-97

Professor and chairman of section
**John F Allen**, PhD (London)

Professor Emeritus
**Anders Kylin**, PhD (Lund)

Research Fellows
**Gunilla Håkansson**, PhD (SLU Uppsala)
**Krassimir Alexciev**, PhD (Sofia).
**Carin Jarl-Sunesson**, PhD (Lund) (SJFR)

Research Students
**Carol Allen**, BSc (Wales)
**Felicia Berggren**, MSc (Umeå)
**Lü-ling Cheng**, MSc (Zhongshan)
**Anna Collén**, BSc (Lund)
**Martha Escobar**, MSc (Lund)
**Jens Forsberg**, BSc (Lund)
**Laure Fraysse**, MSc (Toulouse)
**André Struglic**s, BSc (Lund)
**Anna Tullberg**, BSc (Fribourg)

Postdoctoral Fellows
**Paul Davies,** PhD (Leeds) (CEC Science Plan)
**Paul Davison** PhD (Manchester) (CEC Science Plan)
**Anders Nilsson**, PhD (Umeå) Postdoctoral Fellow (NFR)
**Thomas Pfannschmidt**, PhD (Bochum) (DFG)
**Louise Race**, PhD (London) (NFR)
**Dalibor Stys**, PhD (Prague) (NFR)

Laboratory Assistant:
**Ineke de Jong**, B Tech (Groningen)

Secretary:
**Annalisa Svensson**, BSc (Lund)

Laboratory Superintendant:
**Christer Fahlström**

Guest Researchers
**Todd Silverstein**, PhD (California, Berkeley)
**Anders Nilsson**, PhD (Umeå)
**Hans Dilly-Hartwig**, PhD (Mainz)
**Wang Xiao Jia,** PhD (China)

Enquiries to and further information from:

**Plant Cell Biology**
**Lund University**
**Box 7007**
**S-220 07 LUND**
**Sweden**

Telephone: **(+46) (0)46-222 40 87**
FAX: **(+46) (0)46-222 36 84** and **(+46) (0)46-222 40 09**
Email: **plantcell@plantcell.lu.se**
Street address: **Sölvegatan 35, Lund, Sweden**

# Welcome and introduction

This is the second Report from Plant Cell Biology. It covers our achievements in the years 1994 to 1997.

There can be no doubt - Plant Cell Biology has been brilliantly successful. The first report (1992-93) outlined the reasons for optimism about this new section. We can see in this report that the optimism was justified. During the four years covered here, Plant Cell Biology grew to establish a special identity. The records show twenty members of the section at all levels, and ten countries of origin. Plant Cell Biology, like science itself, is international.

Most serious universities throughout the world describe their purpose as "the advancement and dissemination of knowledge and understanding". "Research" and "teaching" are useful terms, but can be unhelpful, by putting an emphasis on quantity rather than quality, and in seeming to be distinct from each other. Plant Cell Biology scores highly by any sensible criterion. The quality of our work is high, the quantity is exceptional for such a small unit, and the nature of our work is fully consistent with our aim of reaching the highest international standards in what a university department can do.

As regards the advancement of knowledge and understanding, Plant Cell Biology has made a number of major contributions, and is now recognised internationally for creativity and innovation in the areas in which it works. External recognition of these achievements can be measured as the number of invitations to write articles and contribute to lectures, seminars, and meetings, and as the external funding, all awarded competitively, which forms an increasing proportion of our total income.

Dissemination of knowledge and understanding takes many forms, and the way in which dissemination occurs is undergoing a revolution. As regards the more conventional activity of teaching in lectures and laboratory classes, we make a major input into the introductory course "Cells", have a successful graduate course on spectroscopy, and in between, our own product, "Molecular Cell Biology", has been hugely successful. The course was first given in 1994. In 1997, by which time word must have got around in the student population, "Molecular Cell Biology" was the most over-subscribed in the science faculty, and many students, unfortunately, had to be turned away. In real universities, of course, much of the knowledge disseminated is recent knowledge, and stands at the boundary of what counts as existing knowledge at all – the better the university or department, the less clear is the distinction between "teaching" and "research". The remarkable standards of our research seminars throughout this period can be seen in the section "Seminars". Plant Cell Biology looks outwards, and is a contributor, supporter and participant in the Lund Molecular Biology Seminar Series. The importance of this level of external contribution can be illustrated by the fact that Plant Cell Biology research students have had personal, one-to-one contact with two recent Nobel prizewinners, not counting the extraordinary level of the many other distinguished international scientists who have taken a day or two to visit and discuss their, and our, work. Their enthusiasm for what they learn here must count as more than mere politeness.

The student research projects are also difficult to classify as either just "teaching" or "research". Plant Cell Biology has had eighteen first-degree research project students between 1994 and 1997, and these students have come from seven countries. The total numbers for Plant Cell Biology under each year in the faculty's summary booklet exceed those from several much larger departments, and, in some

cases, whole institutions. Again, it is not just numbers, but quality, that matters. Many of the students whose first experience of research was a project with us have gone on to decide that science is for them, and are now doing postgraduate research here or elsewhere.

The revolution in the way in which knowledge and understanding now grow and propagate is information technology. Try the search string “Plant Cell Biology” in any of the internet search engines – not to mention “photosynthesis”, “chlorophyll fluorescence” and any of a host of more specialised terms associated with our work – and see what you get. Every week we receive email messages from many parts of the world enquiring about what we do and how we do it. This written report can only be a supplement to the fuller, dynamic picture that can be obtained from http://plantcell.lu.se. The Plant Cell Biology web site still bears evidence of its evolutionary origin in the report of 1992-3. The web site was one of the first of its kind, being launched early in 1995, and is now linked and recommended as a source of further information on many other sites around the world. An introduction to Plant Cell Biology on the internet is given in the final section of this report.

It is also important to understand that the growing success recorded here is based on a decreasing level of resources – it would not be an exaggeration to say that Lund University “pulled the plug” on this and other sections during the period covered here, as its, and Sweden’s, priorities began to change. The total level of university-funded full-time staffing is just one established member of academic teaching staff, one technician, two postdoctoral fellows and three research students. The inescapable conclusion from this report is not just that Plant Cell Biology is effective – it is also remarkably efficient. These achievements flow from an internal culture of openness and co-operation. The other reason for success is simple commitment. In the Okazaki National Institute of Basic Biology in Japan, where these issues are understood, I was able to finish a lecture in 1995 with an authentic slide of our building taken from a tall building just to the South across Sölvegatan, at dusk in early September. In Plant Cell Biology’s middle floor all the lights are still on.

The remarkable results described here have been produced not just by hard work, which of course you will find, but also by a shared conviction that our subject matters, and our contribution to it matters, too. The achievements are nevertheless those of individual members of the section. I congratulate and thank them. There is much to look forward to.

John F. Allen
26 August 1998

# Research areas

## Some definitions

**Photosynthesis** converts the energy of sunlight into chemical form. Photosynthesis is a series of light-driven redox reactions, one of which involves a single molecule of the green pigment chlorophyll. In plant cells, photosynthesis occurs in chloroplasts, and uses water as a source of hydrogen atoms. This natural, chemical oxidation of water produces and replenishes the oxygen in the earth's atmosphere.

**Respiration** is the useful release of the energy that has been stored by photosynthesis. In animal and plant cells, respiration takes place in mitochondria, and is a series of redox reactions reactions that finally dump hydrogen atoms onto the oxygen molecules originally produced in photosynthesis. We depend totally on respiration and on photosynthesis - for the food we eat and the air we breathe.

**Redox** is short for "reduction and oxidation", and describes the class of chemical reactions that involve transfer of electrons or hydrogen atoms. Redox reactions are fundamental to the way in which all cells obtain, convert, and use energy.

## Mitochondrial gene expression in pea is regulated by the activity of respiratory complex II

Gunilla Håkansson, Martha Escobar

Protein synthesis in isolated pea mitochondria has been shown in this laboratory to be dependent on the activity of respiratory complex II . Inhibition of electron transport through this complex causes complete inhibition of $^{35}$S-methionine incorporation into mitochondrial proteins. The evidence presented points to the redox state of complex II as a regulatory factor in mitochondrial gene expression, although the mechanism of regulation and the level at which control is exerted have not yet been clarified. We have demonstrated partial inhibition of incorporation of $^{32}$P-labelled UTP, in isolated and permeabilised mitochondria, by thenoylfluoroacetone (TTFA), a specific inhibitor of complex II. Our data suggest that although some regulation of transcription seem to occur, the redox state of complex II regulates mitochondrial gene expression mainly at the translational level. We further show that protein synthesis is accompanied by phosphorylation of a 13 kDa protein, not previously detected in phosphorylation assays carried out in pea mitochondria (Håkansson and Allen, 1995). Incorporation of label from [$\gamma$-$^{32}$P]ATP into the 13 kDa protein is also inhibited by TTFA. These observations raise the possibility that protein phosphorylation could play a role in signal transduction between complex II and the mitochondrial protein synthesis apparatus. Our observations support the hypothesis that the mitochondrial genetic system permits direct regulatory control of gene expression upon changes in the redox state of electron carriers of the respiratory chain (Allen, 1993).

## Protein phosphorylation regulates photosynthesis

John Allen, Dalibor Stys, Anders Nilsson, Louise Race, Jens Forsberg, Lüling Cheng, Todd Silverstein, Anna Tullberg, Gunilla Håkansson.

In photosynthesis, protein phosphorylation controls the transfer of absorbed excitation energy and its distribution between the photochemical reaction centres that are the primary traps for conversion of light energy into electron transport and hence into stored chemical potential energy. In 1980 John Allen discovered that the modification, by protein phosphorylation, of a light harvesting chlorophyll-protein complex is itself controlled by the state of oxidation-reduction of a particular electron carrier, plastoquinone. This allowed Allen and co-workers to propose a feedback mechanism to explain a well-known adaptation of green plants to changing light regimes. This work has attracted considerable interest and support and has provided a discernible theme in areas of photosynthesis research during the 1980s. Protein phosphorylation as a purely post-translational regulatory mechanism is still an active area and one yielding new and interesting results in sometimes surprising directions. For example, we have recently published a paper showing that two key subunits of coupling $F_1$-$F_o$ ATPase are phosphorylated in the inner mitochondrial membrane. The subunits together make up the "stator" of the $F_1$-$F_o$ proton-driven rotary motor, where the rotor is the core of $F_o$. This raises the likelihood of physiological regulation of energy coupling in oxidative phosphorylation. A further example is the recent discovery by Louise Race, working with Anna Tullberg and Gunilla Håkansson, that many chloroplast proteins are phosphorylated on tyrosine residues, in addition to the recognised phosphorylations on threonine.

We now view post-translational control of photosynthetic unit function by phosphorylation of light-harvesting proteins as an example of guided molecular recognition. We have proposed that protein phosphorylation causes regulatory structural changes, in contrast to widely-held but unsubstantiated model of altered membrane surface charge. Recent results in Plant Cell Biology and in collaboration with Lund Physical Chemistry 2 show clearly by NMR spectroscopy that phosphorylation causes a major structural change in polypeptides corresponding to the N-terminal domain of the chloroplast light-harvesting protein. FTIR and CD spectroscopy show that the same structural change - helix formation around and including the phosphorylation site - occurs in the native protein. Our 1997 paper in the Journal of Biological Chemistry by Nilsson et al (see publications) was described by one of its referees as “a breakthrough in our understanding of regulation of photosynthesis”. A realistic goal is now complete 3-D structure determination, at atomic resolution, for the phosphorylated and dephosphorylated forms of the chloroplast light-harvesting complex.

## Phosphorylation controls the 3-D structure of plant light harvesting complex II

Anders Nilsson, Jens Forsberg, Dalibor Stys, John Allen

The most abundant chlorophyll-binding complex in plants is the intrinsic membrane protein Light-Harvesting Complex II. LHC II acts as a light-harvesting antenna and has an important role in the distribution of absorbed energy between the two photosystems of photosynthesis. We used spectroscopic techniques to study a synthetic peptide with identical sequence to the LHC IIb N-terminus found in pea, with and without the phosphorylated Thr at the fifth amino acid residue, and to study both forms of the native, full-length protein. Our results show that the N-terminus of LHC II changes structure upon phosphorylation, and that the structural change resembles that of rabbit glycogen phosphorylase, one of the few phosphoproteins where both phosphorylated and non-phosphorylated structures have been solved. Our results indicate that phosphorylation of membrane proteins may regulate their function through structural protein-protein interactions in surface-exposed domains.

## Redox signalling: the reason for genes in chloroplasts and mitochondria?

John Allen, Gunilla Håkansson, Anna Tullberg, Martha Escobar, Louise Race, Carol Allen, Thomas Pfannschmidt.

Post-translational, physiological adaptation responds to the same environmental signals that cause developmental changes in gene expression that operate on longer time-scales. Redox-controlled modification of a transcriptional

activator in cyanobacteria, discovered in John Allen's Leeds laboratory in the late 1980s, establishes such a link between post-translational and transcriptional levels of control. John Allen has put forward the hypothesis that redox control of gene expression explains, in principle, the function of the genomes of chloroplasts and mitochondria and their retention, in evolution, as extra-nuclear genetic systems. If correct, this provides a solution to a long-standing problem in evolutionary cell biology, namely, why do chloroplasts and mitochondria contain distinct genetic systems to express a small but constant sub-set of their own proteins? This hypothesis seeks to explain what these proteins have in common that confers a selective advantage to the location of their genes *in situ* in the organelle. This is a testable hypothesis. We have also put forward a nomenclature for the components of the two distinct systems that are emerging as regulatory mechanisms linking electron transport to transcription of specific genes in bacteria.

Our recent results show specific redox regulation of the pattern of protein synthesis in isolated chloroplasts and mitochondria, consistent with the predictions of the evolutionary hypothesis, described above, for the function of chloroplast and mitochondrial genomes. A further, recent, publication shows that mitochondrial gene expression (as de novo protein synthesis) is controlled by the redox state of respiratory complex II (succinate dehydrogenase). Thomas Pfannschmidt's introduced the imaginative technique of following chloroplast transcription after switching between different growth lights selective for different parts of the photosynthetic electron transport chain. Using this and other techniques, important manuscripts now in preparation for publication show that chloroplast gene transcription is directly under redox regulatory control at the level of the plastoquinone pool - both *in vivo* and *in vitro*, and in two higher plant species.

## Genetic cross-talk: nuclear factors involved in the regulation of photosynthetic efficiency in plants

Krassimir Alexciev, Anna Tullberg, Laure Fraysse

Photosynthesis is performed by dynamic structures in thylakoid membranes, whose components change in quantity in response to external stimuli - intensity and quality of the light, oxygen, etc. These changes suggest tight co-ordination of expression of the exact amounts of chloroplast proteins that are encoded in both chloroplast and nuclear genomes. The concerted expression of plastid and nuclear genes provides the plant cell with a versatile means to adapt to changes in the environmental conditions. The well established, nowadays, fact that nuclear- and chloroplast-encoded proteins are required to assemble a functional chloroplast shows clearly that nuclear and chloroplast genomes interact in at least two ways. First, both nuclear and chloroplast genes contribute to chloroplast protein function. Second, both nuclear and chloroplast genomes interact to affect the synthesis and assembly of chloroplast proteins. The first level of interaction is obvious from the fact that chloroplast gene products do not act alone; they are components of multimeric protein complexes of mixed origin. The second level of interaction, biosynthesis of chloroplast proteins, is obvious from the genetic circuitry involved in chloroplast biogenesis. Communication from the nuclear genome to the chloroplast involves proteins that are translated in the cytosol and imported into the chloroplast.

The entire pathway of plastid gene expression is regulated at various levels: transcription, RNA processing and maturation, translation and post-translationally. We are concentrating our efforts on the study of nuclear-encoded components that are operational in the control of photosynthetic activity in higher plants. Studies from our laboratory indicate that the expression of one of the subunits of the cytochrome $b_6/f$ complex, namely cytochrome $b_6$, is post-transcriptionally regulated through changes in the redox potential in the organelles (Alexciev and Tullberg, 1997). Our results point to specific changes in the stability of *pet*B mRNA in pea organelles, which drastically decreases when the environment is oxidised, while reducing conditions do not change the stability of the message. We proposed that RNA-binding proteins (most likely nuclear-encoded) that get modified, for example by phosphorylation, are involved in the mechanism of selective and regulatable mRNA degradation in the plant chloroplasts.

Studies on the regulation of gene expression in the chloroplasts give clear indications for specific transcriptional regulation of plastid genes in varying light environments

(manuscript in preparation). We believe that again nuclear-encoded transcription factors/modulators are involved in this process.

In the search for nuclear factors regulating the process of photosynthesis we analyse T-DNA tagged *A. thaliana* mutants that show changed fluorescence phenotype (screened by Dr Paul Davison). We have localised the defects at protein complex level in several mutants and are further trying to identify and analyse the mutated nuclear genes in two of them.

## Signalling between plants and microbes

Carin Jarl-Sunesson, Felicia Berggren, Jörgen Borg

In an ecologically sustainable agriculture, it is among several other factors important to minimise the addition of external chemicals. Different types of pesticides as well as the addition of nitrogen by chemical fertilisation are examples of applications for which realistic substitutes have to be found. The use of pesticides can be lowered by improving the disease resistance of the crops. Biological $N_2$ fixation by using legumes in symbiosis with *Rhizobium* can be used to introduce nitrogen to the agricultural systems. To improve and increase these biological alternatives in a commercial agricultural system, we need to understand those processes also from the scientific standpoint.

Communication between plants and microbes has not only important practical implications in agriculture, but it has also a profound scientific interest. The importance in agriculture involve both beneficial symbiotic relationships as with mycorrhiza and *Rhizobium* as well as in the detrimental effects of plant diseases caused by micro-organisms. The interplay and signalling between the two different organisms, the microbe and the plant, as well as the signalling within the plant as a response to the microbial attack or colonisation is scientifically very intriguing and challenging. Also some of the signalling pathways initiated on the one hand by the symbiotic interactions between legumes and *Rhizobium* and on the other hand the interaction between a pathogen and a host plant show some common or corresponding steps.

The invasive infection of legume roots by *Rhizobium* resulting in the formation of a novel plant organ, the nitrogen-fixing nodule, is a very complex set of processes. Likewise, the attack by a plant pathogen on a plant results in a number of processes involving different types of cascade reactions aimed at protection of the plants, but of course also in some cases resulting in the eventual death of the plant.

In this project we are studying the function of genes involved in the pathogenesis response, a chitinase, and genes isolated during the nodulation process of a legume root. By making sense and antisense vectors of those genes, we are able to study the effects of overexpression (sense constructs) as well as inhibition (antisense constructs) of the products of those different genes. The vectors will be introduced into the plants by transformation and regeneration protocols developed in our group. Analysis of the transformed plants will be done on whole-plant level as well as biochemical, molecular and cellular level.

This project is supported by two grants from SJFR and NKJ to Carin Jarl. The *Rhizobium*/legume part will be done in co-operation with Prof. K Lindströms group, Biocenter, Helsinki, where part of their work is supported by the EU-TMR network “Symbiosis and defence”. The work with the PR-proteins, esp. the chitinase, will be done in collaboration with Dr. T Bryngelsson, SLU, Svalöv. At Plant Cell Biology, Lund University, several aspects of plant signalling are studied, especially within the cell and organelles on biochemical, structural, transcriptional as well as on translational level in the projects of Prof. J Allen, Dr. K Alexciev and Dr. G Håkansson. As for the analysis of the transformed plants we will also cooperate with other groups with which we are in contact: Dr. M Svenning, Tromsö University; Prof. K Huss-Danell, SLU, Umeå; Prof. W Heneen, SLU, Svalöv; Dr. H Küster, Univ. Bielefeld.

## Separate sexes and the mitochondrial theory of ageing

John Allen

In the Journal of Theoretical Biology, John Allen has put forward an hypothesis by which gamete specialisation resolves a conflict between the function and replication of mitochondria. Mitochondrial function is synthesis of ATP by

oxidative phosphorylation, coupled to respiratory electron transport. This requires a mitochondrial genetic system. However, “incorrect” electron transfers produce free radicals that cause mutation, and their frequency is itself increased by mutation. Mitochondrial function is therefore detrimental to the fidelity of mitochondrial replication. Damage to somatic mitochondrial DNA may accumulate within, and indeed determine, the life span of individual organisms. Motility of one gamete is required for fertilisation, and requires ATP. It is proposed that male gametes maximise energy production for motility by sacrificing mitochondrial DNA to electron transfer and its mutagenic by-products, while female gametes, which are non-motile, repress mitochondrial oxidative phosphorylation, thus protecting mitochondrial DNA for faithful transmission between generations. Male gametes then make no contribution to the mitochondrial genome of the zygote: mitochondria are maternally inherited. This testable hypothesis may help to explain the evolution of separate sexes and a number of their characteristics. Maternal inheritance of chloroplasts may be explained in a similar way, and contribute to the maintenance of separate sexes in plants.

## Imaging chlorophyll fluorescence

John Allen, Paul Davison

A new technology of time-resolved imaging spectroscopy has been developed and is now applied to the study of cellular responses to stress on different time scales and at different levels of gene expression. The natural fluorescence of chlorophyll in photosynthetic systems is used as a non-invasive probe, by rapid computer acquisition of digitised images of fluorescence. Variations in fluorescence of cells or individuals can then be measured simultaneously in large populations. Thus subtle, adaptive responses can be used for the first time as genetic markers in screening for mutation.

Chlorophyll is the green pigment that harvests and converts light in photosynthesis. Chlorophyll also emits light, as fluorescence, and variations in fluorescence emission report on changes in the efficiency of photosynthesis. We have developed a way to film changes in chlorophyll fluorescence, by computer acquisition of fluorescence images. The coloured pea leaf image on the cover of this booklet was obtained in this way, using leaves that had begun to take up a herbicide that inhibits electron transport in photosynthesis, increasing fluorescence emission from regions around the veins that transport substances into the leaf. Leaves of the small plant thale cress were imaged by a camera that detects chlorophyll fluorescence. Fluorescence was initially high, and falls after six minutes in the as light-harvesting protein becomes phosphorylated. A far-red light, unseen by the camera, is switched on, and fluorescence falls further, to rise slightly after a further two minutes, as the phosphate group is removed from the light-harvesting protein. Mutant plants behave differently, and their fluorescence stays high. Paul Davison, who found the mutant plant using fluorescence imaging, is isolating the tagged gene that causes the defect.

# Research grants and awards

Swedish Council for Planning and Co-ordination of Research (FRN). Equipment grant. *Nanosecond laser photolysis spectrometer and fluorescence imaging spectrometer*. SEK 1,722,000 from September 1992. (JFA)

Swedish Natural Science Research Council (NFR). Research Grant. *Membrane phosphoproteins regulating prokaryote photosynthesis: sequence, structure and regulatory function*. SEK 900,000 (of which 400,000 for equipment) over 2 years from 1 January 1992, plus a second year of support (SEK 210,000) for Dr Stys. (JFA)

Commission of the European Communities, Science Plan. *Protein engineering of the chloroplast light-harvesting complex of photosystem II*. Co-ordinator: J F Allen, Lund. Co-applicants: W Kühlbrandt (European Molecular Biology Laboratory, Heidelberg), A C Cuming (Department of Genetics, University of Leeds, U.K.) ECU 250,000 over three years from 01.10.92, of which ECU 55,407 to Lund over two years from mid-1993. (JFA)

Crafoordska Stiftelsen. *Inköp av spektrometer för kinetikmätning med fluorescens- och absorptionteknik*. SEK 200,000 for equipment, for purchase of Walz PAM flash kinetic fluorescence and absorption spectrometer. 1994. (JFA)

Magn. Bergvalls Foundation. SEK 30,000. 1994. (GH)

Crafoord Foundation. SEK 80,000. 1994. (GH)

Axel Hallströms donation. Travel award to André Struglics. VIII International Symposium on Phototrophic Prokaryotes. SEK 3,300. 1994. (AS)

Norstedts fond. Travel grant to Anna Tullberg.4th International congress of plant molecular biology in Amsterdam. SEK 3,100. 1994. (AT)

Bokelunds fond för resestipendier. Travel grant to Anna Tullberg .4th International congress of plant molecular biology in Amsterdam. SEK 4,000. 1994. (AT)

Kungliga fysiografiska sällskapet i Lund. *Post-transcriptional regulation of photosynthetic activity in pea chloroplasts.* SEK 44,000. 1995 (KA)

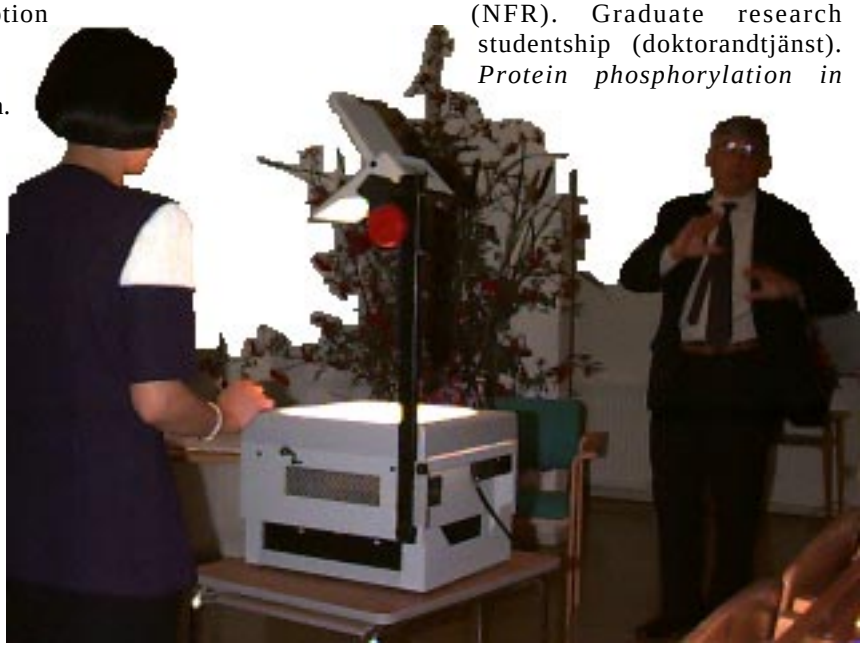
Gleerupska resestipendiet, Lund University. To attend the Xth International Congress on Photosynthesis, Montpelier, France. SEK 4,180. 1995 (KA)

Swedish Natural Science Research Council (NFR). Research Grant. *Molecular and structural effects of protein phosphorylation in photosynthetic membranes* SEK 929,763 over 3.5 years from 1 July 1995. (JFA)

Swedish Natural Science Research Council. (95-97) SEK 684,000. 1995. (GH)

Lund Univ., Bokelund Foundation SEK 5,500. 1995. (GH)

Swedish Natural Science Research Council (NFR). Graduate research studentship (doktorandtjänst). *Protein phosphorylation in*



*photosynthetic membranes*. SEK 860,000 approximately over four years starting 1995/96. Appointed: Mr Jens Forsberg. (JFA)

Crafoordska Stiftelse. *Gene regulation of photosynthetic activity in higher plants through cytochrome $b_6/f$ complex,* co-applicant - P. Davison . SEK 70,000. 1996. (KA)

Mat-nat fakultets fonder, Lund University. To attend the Gordon Research
Conference on Chloroplasts and Mitochondria, New Hampshire, USA. SEK 5,000. 1996. (KA)

Hierta-Retzius stipendiefond. *Protein phosphorylation on mitochondria and chloroplasts in higher plants*. SEK 10,000. 1996. (AS and AT)

Swedish Natural Science Research Council (NFR). Postdoctoral stipend. *Protein phosphorylation in photosynthetic membranes.* SEK 200,000. 1996/97. Appointed: Dr Anders Nilsson. (JFA)

Swedish Natural Science Research Council (NFR). Postdoctoral stipend. *Protein phosphorylation in photosynthetic membranes.* SEK 200,000. 1997/98. Appointed: Dr Louise Race. (JFA)

Kungliga Fysiografiska Sällskapet I Lund (The Royal Physiographical Society in Lund). Dukers fond award. *Xth International Congress on Photosynthesis.* SEK 12,000. 1995. (JFA)

Swedish Council for Planning and Co-ordination of Research (FRN). Equipment grant. *Automated DNA sequencer.* Co-applicant (one of three). Principal applicant: Carl A. K. Borrebaeck, Department of Immuntechnology. SEK 2,000,000. 1996. (JFA)

Kungliga Fysiografiska Sällskapet I Lund (The Royal Physiographical Society in Lund).Travel grant. SEK 3,000. 1996 (AN)

Kungliga Fysiografiska Sällskapet I Lund (The Royal Physiographical Society in Lund). Equipment grant. SEK 86,000. 1996 (AN)

Kungliga fysiografiska sällskapet i Lund. *Signalling cascades in plant cells: Coupling between transcription of plant genes and photosynthetic electron flow*. SEK 30,000. 1997. (KA)

Mat-nat fakultets fonder, Lund University. To attend the XIth International
congress on Photosynthesis, Budapest, Hungary. 7,000. 1997. (KA)

Knut och Alice Wallenbergs stiftelse. Lunds Universitet rese-och forskingsbidrag. S E K 13,000. 1997. (ME)

Carl-Fredrik von Horns fond. Kung. Skogs-och Lantbruksakademien resestipendium. SEK 15 ,000. 1997. (ME)

Knut och Alice Wallenbergs stiftelse. Travel grant to Anna Tullberg . 5th International Congress of Plant Molecular Biology in Singapore. SEK 9,400. 1997. (AT)

Hierta-Retzius stipendiefonder. *Redox regulation of transcription in chloroplasts of higher plants*. equipment grant SEK 11,000. 1997. (AT)

Axel Hallströms donation. Travel grant to Anna Tullberg .5th International Congress of Plant Molecular Biology in Singapore. SEK 9,750. 1997. (AT)

# External seminars, lectures and contributions to scientific meetings

## 1994

January. Glycine rich proteins of the plant cell wall (diploma work, University of Fribourg) (AT)

8 March. Research Seminar "Protein phosphorylation in regulation of photosynthesis", Department of Biochemistry, Odense University, Denmark (JFA)

19-21 March. 3rd German-Swedish Symposium on "Structure and Function of Photosynthetic Reaction Centres" Schloß Reinach, Freiburg-Munzingen, Germany. Invited speaker "Protein phosphorylation and energy distribution". (JFA)

*27-29 March. Plant Cell Biology Workshop on Thylakoid Protein Phosphorylation, Lund University, Sweden. This meeting grew from an extended research seminar invitation to a workshop with fifteen speakers from seven countries. The external speakers were Bertil Andersson (Stockholm University), Eva-Mari Aro (Turku University), Andrew Cuming (Leeds University), Doris Godde (Ruhr-Universität, Bochum), Erika Liker (Hungarian Academy, Szeged), Itzhak Ohad (Hebrew University of Jerusalem) and Francis-André Wollman (Institut de biologie physico-chimique, Paris). The Lund University contributors were Per-Åke Albertsson, Hreinn Stefansson and Cecilia Sundby-Emanuelsson (from Biochemistry), and John Allen, Lüling Cheng, Gunilla Håkansson, André Struglics, Dalibor Stys (from Plant Cell Biology). Krassimir Alexciev, Gunilla Håkansson and Carin Jarl-Sunesson chaired the sessions. The Proceedings of the meeting are published in the journal Physiologia Plantarum:- "Proceedings of a Plant Cell Biology workshop on thylakoid protein phosphorylation. Lund University, Sweden, 27-29 March, 1994. Physiologia Plantarum 93: 171-205, 1995"

27-30 April. Phytochemical Society and Federation of European Societies for Plant Physiology Meeting "Plant Membrane Biology", Lund, Sweden. Member of organising committee. Invited lecture "Redox control of protein phosphorylation in photosynthesis and gene expression". (JA) Poster presentation (GH) Participant (AS) (AT)

1-6 May. Gordon Research Conference, Volterra, Italy, "Extrachromosomal Elements: Mitochondria & Chloroplasts". Invited speaker. "Protein phosphorylation and redox homeostasis in chloroplasts and (other) prokaryotes". (JFA) Poster presentation (KA)

May 30 – June 4. NorFA Researcher Course in Turku

(Åbo), Finland, “Bioenergetics and ion transport in plant cell membranes”. Lecture, “Early developments of concepts in ion transport”. Workshop series, “Scientific writing” (AK)

19-24 June. 4th Int Congress of Plant Molecular Biology, 1994, Amsterdam, The Netherlands. Poster presentation (GH) (CJS) (AT)

June 26-July 1.Fedaration of European Biochemical Societies. Special Meeting, Biological Membranes. Helsinki, Finland. Poster presentation (DS) Participant (AS)

10-15 September. VIII International Symposium on Phototrophic Prokaryotes. Urbino, Italy, (AS)

2 November. Research Seminar, Department of Plant Sciences, Oxford University, U.K. “Redox signals in photosynthesis: a paradigm for chloroplast and mitochondrial gene expression?” (JFA)

3 November. Nature 125th Anniversary Symposium “Our Place in Nature”, The Royal Institution, London, U.K. Participant (JFA)

4 November. Research Seminar, Department of Biological Sciences, Warwick University, U.K. “Redox signals in photosynthesis: structural and evolutionary implications” (JFA)

10-12 December. 34th National Institute for Basic Biology Conference “Responses of the photosynthetic apparatus to environmental light conditions”, Okazaki, Japan. Invited speaker. “Effects of redox potential on thylakoid protein phosphorylation and on chloroplast and mitochondrial protein synthesis” (JFA)

Research seminar. Redox regulation of gene expression in chloroplast and
mitochondria of higher plants. Dept. of Plant Breeding, Swedish Univ. of
Agricultural Sciences, Svalöv (GH)

Research seminar. Specific interactions and molecular recognition in plant thylakoid membranes, Inst. of Organic Chemistry and Biochemistry Czech. Acad. Sci, Prague (DS)

Research seminar. Specific interactions and molecular recognition in plant thylakoid membranes, Inst. Microbiology, Czech. Acad. Sci, Trebon (DS)

Research seminar. Specific interactions and molecular recognition in plant thylakoid membranes, South Bohemian University, Ceske Budejovice (DS)

## 1995

17 January. Planning Meeting for Strategic Research Foundation Proposal “Molecular Redox Signalling”, Biochemistry Department, Stockholm University, Sweden (JFA)

February 7-8. Course “Scientific authorship”, Swedish Agricultural University, Uppsala (AK)

9 March. Research Seminar “Redox signals in photosynthesis: structural and evolutionary implications”. Max-Planck-Institut für Strahlenchemie, Mülheim, Germany (JFA)

10 March. Research Seminar, Department of Botany, University of Münster, Germany (JFA)

11 March. German Physiological Society International Symposium “Mechanisms of oxygen sensing to regulate ion channel activity and gene expression”, Münster, Germany. Invited speaker: “Redox control of gene expression in chloroplasts and mitochondria” (JFA)

March 14-15. Course “Scientific authorship”, Swedish Agricultural University, Uppsala (AK)

7-12 April. International Conference on Plant Mitochondria: From Gene to Function, Durham, North Carolina, USA. Poster presentation (GH)

25 April. Research Seminar “Redox signals in photosynthesis: implications for chloroplast and mitochondrial genomes”. Glynn Research Foundation, Bodmin, Cornwall, U.K. (JFA)

16-20 August. International Workshop on Light-Harvesting Systems, Nant, France. Two poster presentations (JFA)

20-25 August. Xth International Congress on Photosynthesis, Montpellier, France. poster presentation and contributions to two discussion sessions. (JFA) Poster presentation (KA) (AS) (DS) (AT)

19-21 November. Swedish Natural Science Research Council Symposium “Molecular structure, function and dynamics”, Lund, Sweden (JFA)

ESF research conference on The Molecular Basis of Biological Membrane Protein Structure and Function, Seeheim, 1995 (DS)

ESF workshop on light-harvesting systems, Nant (DS)

The mitochondrial genome: structure and expression Dept. of Genetics, Lund University, Sweden (GH)

Studies on phosphorylation dependent adaptation of plant thylakoid membranes, Universität Münster (DS)

Peptide competition studies on plant thylakoid membranes: domain formation and colloid behaviour, University of Chemical Technology, Prague (DS)

Peptide competition studies of protein-protein recognition and its control in chloroplast thylakoid membranes, Faculty of Mathematics and Physics, Charles University, Prague, 1995 (DS)

Protein recognition, adaptation and phase changes in thylakoids, Institute of Microbiology, Trebon (DS)

Peptide competition studies of protein-protein recognition and its control in chloroplast thylakoid membranes, ESF conference The Molecular Basis of Biological Membrane Protein Structure and Function, Seeheim (DS)

## 1996

February 6-7 Course “Scientific authorship”, Swedish Agricultural University, Uppsala (AK)

March 12-13 Course “Scientific authorship”, Swedish Agricultural University, Uppsala (AK)

24-29 March. Conference Jacques Monod de la CNRS, Aussois, France, “Synthesis and function of photosynthetic complexes”. Invited speaker “Redox control of synthesis and phosphorylation of chloroplast proteins”. Three poster presentations, and chairman of session “Structure and function of light-harvesting systems” (JFA)

17-20 April. 15th Annual Missouri Symposium on Current Topics in Plant Biochemistry, Physiology and Molecular Biology, “Phosphorylation-Dephosphorylation of Plant Proteins”, University of Missouri, Columbia, MO, U.S.A. Invited lecture “Redox control of chloroplast thylakoid protein phosphorylation: structural and evolutionary implications” (JFA) (AS)

17 May. Ruhr-Universität Bochum. Biology Graduate School, International Scientific Symposium “Developmental Signalling”, Bochum, Germany. Invited lecture “Redox signalling” (JFA)

24-26 May. Universität Regensburg. "The Cytochrome $b_6$f-Complex - Electron Transfer, Proton Translocation and Redox Sensing" Workshop within the ESF-program "Biophysics of Photosynthesis". Invited speaker. “Redox signals from the chloroplast thylakoid: structural and evolutionary implications” (JFA)

10-19 June. NorFA workshop on “Photosynthesis in a changing environment - a molecular approach”, Turku, Finland (KA) (AT)

16-21 June. Gordon Research Conference on Chloroplasts and Mitochondria, Plymouth, New Hampshire, U.S.A. (KA)

27-29 September. European Science Foundation Workshop "Molecular Recognition in Photosynthesis", Jaca, Spain. Invited speaker. "Phosphorylation directs molecular recognition through helix formation at the N-terminus of chloroplast light-harvesting complex II" (JFA)

25-27 October. Third Nordic Congress on Photosynthesis, Sigtuna, Sweden. Joint chairman of session Structural and Dynamic Aspects of Natural and Artificial Photosynthetic Membranes. (JA) Participant (JF)

7 November. Seminar Redox control of chloroplast thylakoid protein phosphorylation and regulation of light-harvesting function: structural and evolutionary implications. University of Würzburg, Germany (JFA)

Signalling cascades in plant gene expression: Regulation of the photosynthetic activity in

chloroplasts, Dept. Biol., Washington University, St Louis, MO, U.S.A. (KA)

Redox regulation of gene expression in mitochondria. Dept. of Plant Breeding and Dept. of Forest Genetics, Swedish Univ. of Agricultural Sciences, Uppsala (GH)

6 December. Studies on the light harvesting complexes of a newly described photosynthetic bacterium. Diploma work seminar at Section for Plant Cell Biology, Lund University (JF)

## 1997

20-30 May. NATO- Advanced Study Institute, Co-sponsored by FEBS, Maratea, Italy (ME)

June 12-17. XVIII Congree of the Scandinavian Society for Plant Physiology, commemorating the fiftieth anniversary of the society. Lecture “The SPPS in an historical perspective” (AK)

17-20 September. 4th German-Swedish Photosynthesis Symposium, Vilm, Germany. Invited speaker. "Evidence for a 3-D structural change upon phosphorylation of LHC II and for complementary redox control of chloroplast transcription". Chairman of session (JFA)

21-27 September. 5th International Congress of Plant Molecular Biology, Singapore. Oral Presentation (CJ) Poster Presentation (AC) (ME) (GH) (AT)

# Seminars

Plant Cell Biology Seminar Series and *Plant Cell Biology contributions to the Lund Molecular Biology Seminar Series

## 1994

11 January
Anna Tullberg (Växtcellbiologi, Lunds Universitet)
Induction of a glycine-rich protein (GRP1.8) in hypocotyls of *Phaseolus vulgaris* upon infection with *Pseudomonas syringae* pv *lachrymans*

18 January
Torbjörn Drakenberg (Fysikalisk kemi, Lunds Universitet)
Magnesium NMR studies of magnesium binding to proteins

1 February
Reinhold G. Herrmann (Ludwig-Maximilians universität, München)
The structure of chromatin

24 February
P. Leslie Dutton (Johnson Research Foundation, University of Pennsylvania,)
Roles of quinone in bacterial energetics

*March 16
Hartmut Michel (Max-Planck-Institut für Biochemie, Frankfurt/Main)
Recent Progress in Studying Structure Function Relationships in Photosynthetic Reaction Centres from Purple Bacteria

12 April
Gerhard Link (Ruhr-Universität, Bochum)
Plastid transcription and its connection to other cell functions

13 April
Paul Davison (Department of Genetics, Leeds University)
Trichome differentiation in Arabidopsis: cloning ttg

May 18
*Louise N. Johnson (Laboratory of Molecular Biophysics, Oxford University)
Control by reversible phosphorylation: Structural lessons learnt from glycogen phosphorylase and implications for other proteins

31 May
John A. Raven (Department of Biological Sciences, University of Dundee)
High oxygen levels and oxygen radical production: influence on metabolism, mutation and gene location

Sept 13
Dalibor Stys (Lund University)
Specific interactions and molecular recognition in adaptation of thylakoid membranes

Sept 27
Matthias Rögner (Universität Münster)
Localisation of subunits in Photosystem 1 and 2 and a Photosystem 2/Light-harvesting supercomplex

Oct 4
Huashi Gong (University of Oslo)
Light-dependent turnover of the photochemical reaction centre II D1 protein

Oct 11
Gerald Schönknecht (Universität Würzburg)
Calcium-induced calcium release and cytoplasmic calcium oscillations in a unicellular green alga
(Jointly with Plant Biochemistry)

Oct 12
Gerald Schönknecht (Universität Würzburg)

The relationship between photosynthetic electron transport and the trans-thylakoid pH gradient in intact leaves
(Jointly with Plant Biochemistry)

Oct 18
Lee McIntosh (Michigan State University)
Interaction of nuclear and organelle genomes

Oct 19
*Alexander von Gabain, (Institut für Mikrobiologie und Genetik, Vienna Biocenter, Universität Wien.)
RNase E and chaperonin; components of mRNA decay in *E. coli* and their mammalian homologues.

Oct 25
Örjan Wrange (Karolinska Institutet)
Glucocorticoid receptor binding to DNA in chromatin

Nov 1
Knud Henningsen (Royal Veterinary & Agricultural University, Copenhagen)
The genetic control of chlorophyll biosynthesis

Nov 8
Lars Rask (Swedish Agricultural University, Uppsala)
The myrosinase/glucosinolate system in Brassicaceae

Nov 15
Kristina Glimelius, **(**Swedish Agricultural University, Uppsala)
Nuclear-organelle interactions in Nicotiana and Brassica"

Dec 6
Dan I. Andersson, (Biomedical Centre, Uppsala)
Regulation of vitamin B12 biosynthesis in *Salmonella typhimurium*

Dec 20
Arne Holmgren, (Karolinska Institutet, Stockholm)
Structure of thioredoxin and glutaredoxin and their role in redox regulation

## 1995

8 February
*Richard Cogdell, (Glasgow University)
High-resolution crystal structure of a bacterial light-harvesting complex (integral membrane protein).

2 March
R. John Ellis (University of Warwick)
The roles of molecular chaperones

3 March
R. John Ellis (University of Warwick)
Competing models of chaperonin action

28 March
Jan M. Anderson (Co-operative Research Centre for Plant Science, CSIRO, Canberra)
Transformation of tobacco with antisense RNA directed against the chloroplast Rieske FeS and ATP δ nuclear-encoded polypeptides

5 April
*Gottfried Schatz, (Biozentrum der Universität Basel)
How mitochondria import and degrade proteins.

20 April
Kristina Lindström, (University of Helsinki)
Molecular Biology of the *Galega-Rhizobium galegæ* symbiosis

3 May
*John Gray, (University of Cambridge.)
Regulation of expression of the pea plastocyanin gene.

9 May
Michael Harrison, (University of Leeds)
Probing the structure of the 16 kDa V-ATPase proteolipid - a promiscuous protein with diverse functions

16 May
Klaas-Jan van Wijk, (Stockholm University)
In vitro incorporation of the D1 protein into Photosystem II

Sept 5
Nicholas Tsinoremas, (Texas A & M University)
Regulation of gene expression in cyanobacteria by light
and the circadian clock

Sept 26
Lüling Cheng, (Lund University)
Redox control of protein phosphorylation in chloroplast thylakoid membranes

Sept 28
William A. Cramer, (Purdue University)
Novel structure-function aspects revealed by a high resolution structure of chloroplast cytochrome *f*

Sept 29
PhD disputation**.** Candidate: Lüling Cheng. Faculty's opponent: William A. Cramer. Chairman: Christer Larsson
Redox control of protein phosphorylation in chloroplast thylakoid membranes

Oct 10
David B. Stern, (Cornell University)
Post-transcriptional regulation of chloroplast gene expression

Nov 1
*Lars Ernster, (Stockholm University)
The merger of bioenergetics and molecular biology

Nov 14
Kleoniki Gounaris, (Imperial College, London)
Protein phosphorylation and oxidative damage

Nov 21
Kenneth Sauer, (University of California and Lawrence Berkeley Laboratory)
Excitation transfer dynamics in photosynthetic antenna pigments

Dec 12
Lars-Gunnar Franzén, (Göteborg University)
Targeting of precursor proteins to chloroplasts and mitochondria in the green alga *Chlamydomonas reinhardtii*

## 1996

Tilmann Wurtz, (Karolinska Institutet, Stockholm)
Structure and function of chromatin

January 31
*Carl E. Bauer (Indiana University Bloomington )
Regulatory circuits controlling photosynthesis gene expression

Feb 6
Karen Kindle, (Cornell University)
Chloroplast gene expression and chloroplast protein import in Chlamydomonas

Feb 8
R. John Ellis, (Warwick University)
Protein assembly: the roles of molecular chaperones

Feb 9
R. John Ellis, (Warwick University)
The Anfinsen cage model for chaperonin action

Erik Fries, (Uppsala University)
Intracellular transport of secretory proteins

Gunnar von Heijne, (Stockholm University)
Cell compartmentalisation and intracellular protein sorting

Feb 27
Thomas Pfannschmidt, (Ruhr Universität Bochum)
The plastid transcription apparatus of mustard (Sinapis alba L.)

Urban Lendahl, (Karolinska Institutet, Stockholm)
Cell differentiation and developmental biology

Anders Zetterberg, (Karolinska sjukhuset)
Control of the eukaryotic cell cycle

March 12
Anders Nilsson, (Lund University)
Proton pumping in bacteriorhodopsin

André Struglics, (Lund University)
Protein phosphorylation in plant mitochondria

May 28
Conrad W. Mullineaux, (University College, London)
Light-harvesting in cyanobacteria

June 4
Giles Johnson, (Manchester University)
Photoactivation, photoinhibition and photoprotection

June 11
Peter Horton, (Sheffield University)
Regulation of the function of light-harvesting complexes of photosystem II

June 12
Jens Forsberg, (Lund University)
Studies of the light-harvesting complex of a newly-described purple photosynthetic bacterium

Sept 12
Hans C.P. Matthijs (Department of Microbiology, University of Amsterdam)
A multifunctional role for ferredoxin-NADP oxidoreductase in photosynthetic and respiratory electron transfer in the
cyanobacterium Synechocystis PCC 6803

## 1997

Feb 4
Todd Silverstein, (Willamette University, Oregon)
Electron transfer & the function of the chloroplast cytochrome $b_6f$ complex

Feb 5 and 6
John Ellis, (University of Warwick)
Protein assembly inside the living cell. The roles of molecular chaperones: the Anfinsen cage model for chaperonin action

Feb 14
Gunnar von Heijne, (Stockholm University)
Compartmentalisation & cellular sorting: Bacterial secretion. Protein targeting to chloroplasts and mitochondria

Feb 17
Erik Fries, (Uppsala University)
Intracellular transport of secretory proteins

Feb 19
*Richard Cammack (King's College, London).
What can EPR spectroscopy tell us about enzyme structure and mechanism?

Feb 20
Jan Nedergård, (Stockholm University)
Cell signalling: Receptors & intracellular signalling systems

Feb 26
Urban Lendahl, (Karolinska Institutet)
Cellular differentiation & developmental biology

Feb 28
Klas Wiman, (Karolinska Institutet)
Eukaryotic cell cycle control

March 4
Sandra Wright, Cornell University
The genetics of antibiotic production in Erwinia herbicola and the role of antibiotics in biocontrol of Erwinia amylovora

April 8
Al McEwan, University of Queensland, Brisbane
Oxygen & light sensing in the regulation of photosynthesis gene expression in Rhodobacter sphaeroides

April 22
Peter R. Rich, University College, London
Charge movement in proteins: from cytochromes to protonmotive oxidase

April 29
Helen L. Race, (Dundee University)
Throwing some light on thylakoid protein kinases

June 10
Hans-Guenther Dilly-Hartwig, (Inst. f Allgemeine Botanik, Johannes Gutenberg-Universität Mainz )
Reconstituted, phosphorylated light-harvesting complex: Investigation of the functional significance of the N-terminal variability

Oct 8
*Dan-E. Nilsson (Department of Zoology, Lund University)
The origin of vision and real animals

Oct 21
Ilian Simidjiev, (Institute for Plant Biology, Biology Research Centre, Szeged)
Role of thylakoid lipids in the organisation and structural flexibility of light harvesting chlorophyll a/b complex of photosystem II (LHCII)

Oct 22
*Urban Lendahl (Karolinska Institutet)
Transgenic analysis of early CNS development - studies of notch and nestin

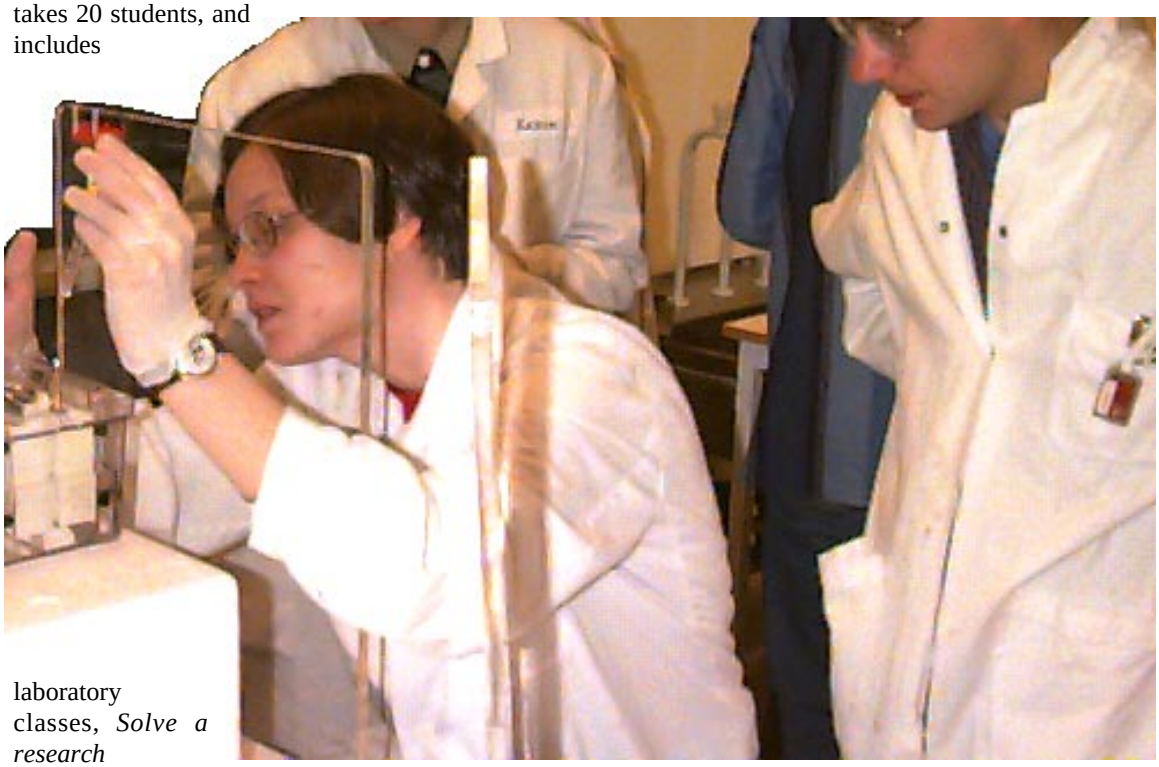
Dec 9
Margareta Ryberg, Botanical Institute, Department of Plant Physiology, Göteborg University
ATP enhances phototransformation of protochlorophyllide in vitro - does reversible protein phosphorylation play a role in etioplast to chloroplast development?

# Teaching: formal courses

***Molecular Cell Biology***

Contact: Dr Gunilla Håkansson
Plant Cell Biology, Lund University, Box 7007, S-220 07 Lund, Sweden,
phone: +46-46-227783, fax:+46-46-2224009
email: gunilla.hakansson@plantcell.lu.se

We offer a 10-point *C* level course (advanced undergraduate) called *Molecular Cell Biology*, using Alberts et al. *The Molecular Biology of the Cell* (Garland Publishing) as reference text, and recruiting a number of specialist lecturers from within Lund University, from elsewhere in Sweden, and from England. The course currently takes 20 students, and includes laboratory classes, *Solve a research problem*, and research projects. This course has become one of the most popular and sought-after courses in the Lund Science Faculty, and we are currently considering a request to double the intake of students.



***Cells***

Contact: Dr Carin Jarl-Sunesson
Plant Cell Biology, Lund University, Box 7007, S-220 07 Lund, Sweden,
phone: +46-46-2220124, fax:+46-46-2224009
email: carin.jarl@plantcell.lu.se

A ground level course in the Biology-Geology section of the Faculty of Mathematics and Natural Sciences.

***Spectroscopy: CD and FTIR***

Contact: Dr Anders Nilsson
Plant Cell Biology, Lund University, Box 7007, S-220 07 Lund, Sweden,
phone: +46-46-2220130, fax:+46-46-2224009
email: anders.nilsson@plantcell.lu.se

A practical course in the Lund Biomedical Graduate Research School.

# Student research projects

In the period covered by this report, 1994-97, a number of students have come to do short term projects in Plant Cell Biology. Many of these students have been doing projects that contribute to the final year course of their degree, some from within Sweden, and many from outside, Erasmus students.

## 1994

Ineke de Jong (Groningen)
Supervisor: Carin Jarl-Suneson
Transformation and regeneration of immature embryos of barley.

Knut Kotarsky
Supervisor: Gunilla Håkansson
How are regulation systems distributed among bacteria closely related to mitochondria and chloroplasts?

Klaske Lok (Groningen)
Supervisor: Carin Jarl-Suneson
Transformations of barley with the Particle Gun, and of *Brassica napus, Arabidopsis thaliana* and tobacco with *Agrobacterium tumefaciens.*

Martin Stancek
Supervisor: Dalibor Stys
Identification, localisation and activity of phosphorylation enzymes and phosphoproteins in chloroplast thylakoid membranes

## 1995

Anna Collén
Supervisor: Carin Jarl-Suneson and Jørgen Larsen
Hur fungerar "hösnuvegenen?"

Martha Escobar
Supervisor Gunilla Håkansson
How do respiration inhibitors affect the protein synthesis in pea mitochondria?

Malin Hultberg
Supervisor: Carin Jarl-Suneson
Växter och Molekylärbiologi

Marleen Van Looveren (Antwerp)
Supervisor: Carin Jarl-Suneson
The function of a chloroplast heat shock protein

## 1996

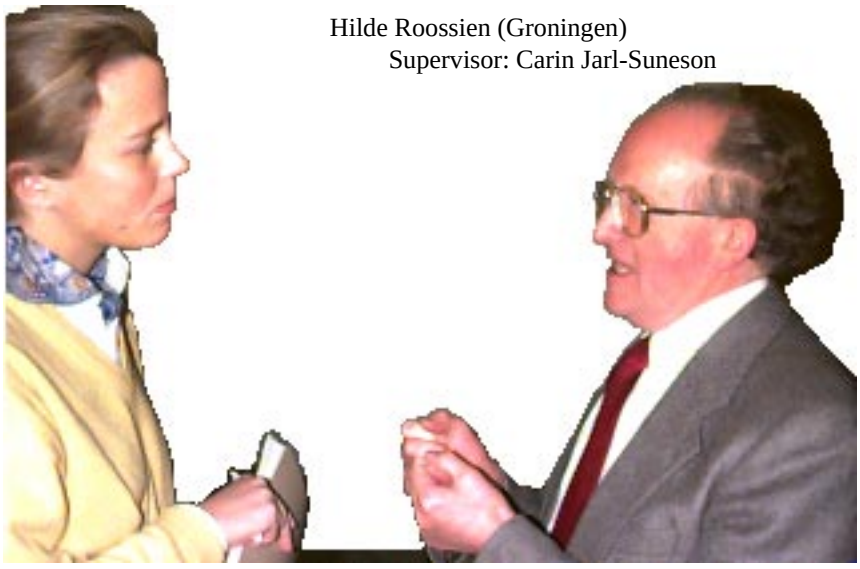
Jens Forsberg
Supervisors: R.J.Cogdell (Glasgow University) and John F. Allen
Fotosyntetiserande bakterier – hur gör de?

Violaine Guené (Lannion, France)
Supervisors: John F. Allen and Paul Davison
Investigating mutant plants that do not like red light; what genes are responsible?

Mikael Herlevsen
Supervisors: Iain Hagan (Manchester university), Douglas Drummond (Manchester university), John F. Allen and Susanne Widell
Samma sekvens, annan funktion?

Laurence Mazé (Lannion, France)
Supervisors: Krassimir Alexciev and Anna Tullberg
Missing bridges between gene expression and development of pea plants

Hilde Roossien (Groningen)
Supervisor: Carin Jarl-Suneson



Adding new genes to barley and *Arabidopsis thaliana* L. using different plasmids.

Kristina Santén
Supervisors: Krassimir Alexciev and Paul Davison
Naturens viktigaste orkester

Marly van den Boom (Groningen)
Supervisor: Krassimir Alexciev
“Green engines of life”

## 1997

Anna Johnson
Supervisor: Carin Jarl-Suneson
The chloroplast small heat shock protein in transgenic *Arabidopsis thaliana*

Tobias Kurz (Braunschweig)
Supervisor: Carin Jarl-Suneson
Transformation of barley using “particle bombardment”

Bartosz Szczesny (Poland)
Supervisors: Gunilla Håkansson and Hanna Janska (Poland)
Cold induced proteins in mitochondria

# Other professional activities

## Research councils and funding agencies

Krassimir Alexciev reviewed a grant application for the Israel Science Foundation.

John Allen reviewed grant applications for the Science and Engineering Research Council, Agriculture and Food Research Council, Biotechnology and Biological Sciences Research Council, European Molecular Biology Organisation, Human Frontiers Science Program Organisation, International Science Foundation, Natural Environment Research Council, Netherlands Science research council (ZWO), Society for General Microbiology, US Department of Agriculture, US Department of Energy , US National Science Foundation, United States-Israel Binational Agricultural Research and Development Fund, and other societies and foundations.

## Journals

Krassimir Alexciev refereed papers submitted for publication to International Journal for Biochemistry, Physiologia Plantarum, Plant Molecular Biology and Gene.

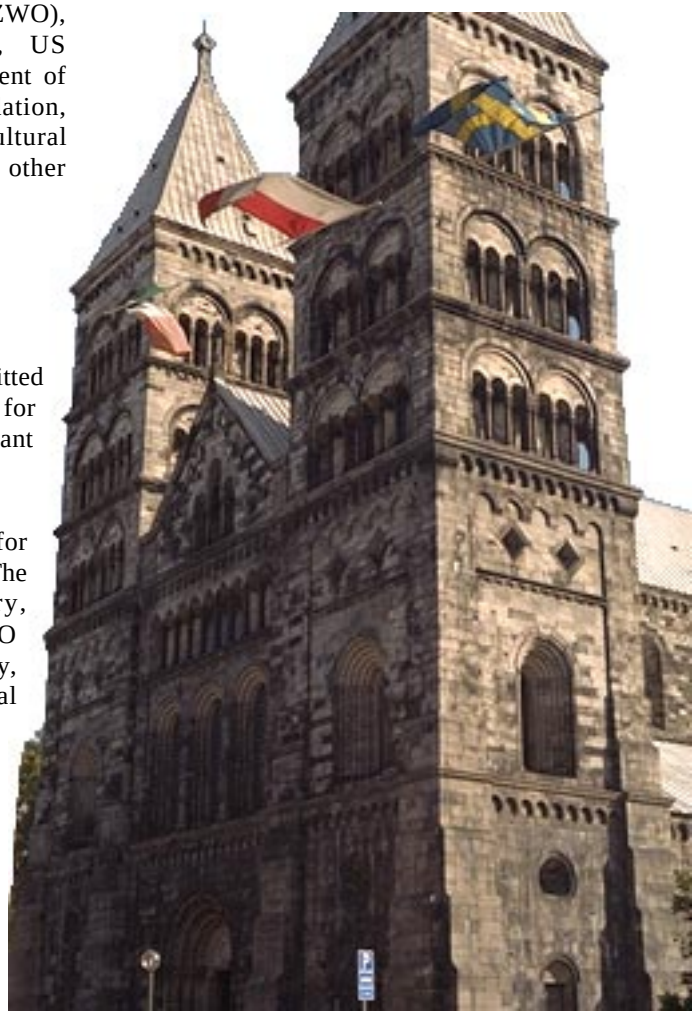
John Allen refereed papers submitted for publication to Archives of Microbiology, The Biochemical Journal, Biochemistry, Biochimica et Biophysica Acta, EMBO Journal, European Journal of Biochemistry, FEBS Letters, Journal of Experimental Botany, Journal of Luminescence, Molecular Microbiology, Nature, Nature Structural Biology, Photosynthesis Research, Physiologia Plantarum, The Plant Cell, The Plant Journal, Plant Physiology, Plant Physiology and Biochemistry, Proceedings of the National Academy of Sciences (U.S.A.), The New Phytologist, and Science (Washington D.C.).

Anders Kylin edited the journal Physiologia Plantarum.

## Universities

Selection Committee. Chair of Plant Physiology, University of Copenhagen, March-October 1993 (JFA).

John Allen evaluated promotion and other applications for universities in Europe, S. Africa, and the United States.



Scientific reviewer of the work of Dr Björn Ingemarsson, Botany Department, Stockholm University, in connection with his application to be given the title “docent”. (AK)

Anders Kylin was a member of “Committee for Biology” appointed by the Association of Universities in the Netherlands (VSNU). The report of the committee “Quality assessment of research: Netherlands biology in the nineties” (ISBN 90-801015-7-5) appeared in April 1994 and has been discussed during the year.

## Examining

### 1994

7 March. Odense University. Opponent in PhD examination of Rene Juhler, Department of Biochemistry (JFA).

13 May. Lund University. Opponent in PhD examination of Cecilia Hägerhäll, Department of Microbiology (JFA).

May 26. Faculty opponent for the public disputation of the thesis “Efflux of potassium from roots of barley and sunflower” preseneted by Åsa Kasimir Kelmedlsson for her doctor’s degree at the Department of Plant Physiology, Swedish Agricultural University, Uppsala. (AK)

### 1995

External examiner, Molecular Cell Biology, Medical Faculty, Lund University (JFA)

8 December. Lund University. Committee member in PhD examination of Fredrik Johansson, Department of Plant Biochemistry (JFA).

Reviewer of scientific achievments of a candidate for the “Best Young Researcher Award”, Kuwait University. (AK)

Commissioned to correct the written examination tests for persons holding an academic degree and applying for employment in the offices of the European Commission in Brussels. (AK)

### 1997

Opponent in PhD examination of Reeta Kettunen, Department of Biology, University of Turku, Finland (JFA).

## Other activities

Anders Kylin was the recipient of a gift from the “Research Institute for Bioresources”, namely, a copy of the facsimile edition of Wilhelm Pfeffer’s personal, interfoliated, working copy of the first edition of his text-book “Pflanzenphysiologie”. In this copy, he wrote down the comments and revisions that he wanted to introduce in the second edition. The gift has been deposited in Lund University Library, which is planning an exposition around the work. Professor Wilhelm Pfeffer, University of Leipzig in Germany, is one of the absolute top names in the history of plant physiology. When he passed away in 1920, his library was brought to Japan and placed in what was later to become the Research Institute for Bioresources, thus making Kurashiki a city of great interest for plant science history.

Anders Kylin was the recipient of the “Linné Gold Medal” of the Royal Phyiographical Society in Lund for collected activities in botanical science.

# Publications

## 1994

ALEXCIEV K, ALLEN C A, ALLEN J F, CHENG L, DRAKENBERG T, FORSÉN S, HÅKANSSON G, SILVERSTEIN T, SPANGFORT M, STYS D, and TULLBERG A (1994)
Protein phosphorylation and energy distribution. Biological-Chemistry-Hoppe-Seyler 375 (SPEC. SUPPL. 1): S3

CHENG, L, SPANGFORT, M D and ALLEN, J F (1994)
Substrate specificity and kinetics of thylakoid phosphoprotein phosphatase reactions. Biochim. Biophys. Acta 1188, 151-157

FREDLUND, K M, STRUGLICS, A, WIDELL, S, ASKERLUND, P, KADER, J- C. and MØLLER, I M (1994)
Comparison of the stereospecificity and immunoreactivity of NADH-Ferricyanide Reductases in Plant Membranes. Plant. Physiol. 106, 1103-1106

HUANG DI, CHEN H, CHENG L (1994)
Serological study of antibodies Epstein-Barr virus specific DNase (EDAb) as a method for early detection of nasopharyngeal carcinoma (NPC). Chinese Journal of experimental and clinical virology 8, 4-11

JARL, C I, KARLSSON, G M, BORNMAN, J F and BORNMAN, C H (1994)
Chloroplast ultrastructure and fluorescence response of oilseed rape containing male sterile radish cytoplasm. In Vitro Cellular and Developmental Biology 30, 4-9

NORE, B F, HARRISON, M A, KEEN, J N and ALLEN (1994)
Partial purification of a cyanobacterial membrane protein with amino terminal sequence similarity to the N-methylphenylalanine pilins. Acta Chemica Scandinavica 48, 578-581

## 1995

ALEXCIEV, A and TULLBERG, A (1995)
Redox-dependent *petB* mRNA turnover in pea chloroplasts, in Mathis, P. (ed), *Photosynthesis: from Light to Biosphere* Kluwer Academic Publishers, Dordrecht. Vol. III pp 659-662

ALLEN, C A, HÅKANSSON, G and ALLEN, J F (1995)
Redox conditions specify the proteins synthesised by isolated chloroplasts and mitochondria. Redox Report 1, 119-123

ALLEN, J F (1995)
Thylakoid protein phosphorylation, state 1-state 2 transitions, and photosystem stoichiometry adjustment: redox control at multiple levels of gene expression. Physiol. Plant. 93, 196-205

ALLEN, J F (1995)
Forward to "Proceedings of a Plant Cell Biology workshop on thylakoid protein phosphorylation. Lund University, Sweden, 27-29 March, 1994. Physiologia Plantarum 93: 171-205, 1995". Physiol. Plant. 93, 172

ALLEN, J F (1995)
Scientific correspondence. Origins of photosynthesis. Nature 376, 26.

ALLEN, J F, ALEXCIEV, K. and HÅKANSSON, G. (1995)
Photosynthesis. Regulation by redox signalling. Curr. Biol. 5, 869-872

ALLEN, J F, DAVIES, P N, FORSBERG, J, HÅKANSSON, G and TULLBERG, A (1995)
Acid-labile, histidine phophoproteins in chloroplasts and mitochondria: possible candidates for redox sensor kinases. In: Mathis, P. (ed.) *Photosynthesis: from Light to Biosphere* Kluwer Academic Publishers, Dordrecht. Vol. III pp 699-702

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# Plant Cell Biology and the internet

If the purpose of a university is the advancement and dissemination of knowledge and understanding, it is clear that information technology in general and the internet in particular are new and revolutionary tools.

In this new medium, a publication may be made freely available, without geographical restriction. The content of a publication may include animation, sound, and references to other publications or parts thereof. The simple device of hypertext links allows the reader to follow a reference immediately. Molecular graphics may be presented interactively. Source files containing such things as text, graphics, sound, and atomic coordinates can be retrieved and used independently. "Search" functions allow retrieval of specific items of information and their context.

The world-wide-web pages listed below are additional evidence of scientific and educational output.

Current internet protocol downloads from all sites within the domain http://plantcell.lu.se/ are completely international. External downloads averaged 1,527 files ("hits") and 20.09 megabytes per day over the period from January 1st to March 16th, 1998.

Each member of Plant Cell Biology has his or her own subdomain to which he or she has free access over the local network. At least one of these (http://plantcell.lu.se/jens/) has been developed by its owner into an independently useful resource, and even visitors (e.g. http://plantcell.lu.se/hans/) seem keen to leave a record of what they have done. The Lund University Plant Cell Biology AppleTalk Zone, to which the file server and all Plant Cell Biology personal computers are connected, also acts as a repository for shared software and is extensively used internally for joint projects, such as writing papers, that involve file sharing and file transfer between members of the department.

**Plant Cell Biology, Lund University, Sweden.**

**http://plantcell.lu.se/**

This is the parent site, presenting Lund Plant Cell Biology, its members, its work and its achievements. The extent of its use can be seen from the records on http://plantcell.lu.se/webstat.html

This site was featured* by Apple Computer as The Apple Computer Made With Macintosh Success Story for the week of January 13-20, 1997.

**Overview of Research**

**http://plantcell.lu.se/research/**

This page presents an overview of the Department's research and contains hypertext links to explanatory pages on selected topics, some of which include molecular graphics.

**Lund Molecular Biology Seminar Series**

**http://plantcell.lu.se/seminars/lmbs/**

This is used primarily within Lund University. It contains a searchable database of seminars and abstracts with contact information for those who may wish to meet speakers informally. Representatives of the ten or so participating departments are themselves able to enter data as new information becomes available to them.

**Molecular Cell Biology**

**http://plantcell.lu.se/mcb/**

Starting in January 1998, our advanced undergraduate course Molecular Cell Biology will have has its own pages. These contain information on the lecture course, with hypertext links supplied by the lecturers as supplementary reference material. Students have the option of

delivering course work electronically as uploads to the site. The complete laboratory class manual can be downloaded or read on-line by students registered for the course.

**Protein phosphorylation in photosynthesis, Sigtuna, Sweden, August 1-5 1998**

**http://plantcell.lu.se/phos98/**

This site announces a forthcoming meeting. Most of the applications to date from paying participants were made in response to this site and to the related announcement made on selected Bioscience news groups.

**Light, time, and micro-organisms**

**http://plantcell.lu.se/ltm/**

This site is an experiment in interactive presentation of concepts in a forthcoming review article and an invited lecture in a Society for General Microbiology symposium.

1. Allen, J F (1998) Light, time and micro-organisms. In: Caddick, M. X., Baumberg, S., Hodgson, D. A. and Phillips-Jones, M. K. (Eds.) Microbial responses to light and time. Cambridge University Press, Cambridge. pp. 1-31

***The Apple Computer Made With Macintosh Success Story**

For the week of January 13-20, 1997.

The feature for the previous week was “The unofficial X-files site”. The following is the “bio” that Apple requested, and featured with the front-page logo and a link to the site.

Plant Cell Biology, Lund University, Sweden - http://plantcell.lu.se/

Plant Cell Biology is a young department. It was started by Lund University in 1992, when John Allen became its first Professor of Plant Cell Biology. The Plant Cell Biology web site has evolved in a way that would have been impossible without Macintosh, and without the breakthrough that was System 7. It also demonstrates that a Mac is longer-term investment than lesser machines. Among the basic requirements for the new Department were a Quadra 950 (one of the first in Sweden), two IIsi's, and an overdue link-up of the Plant Biology Building to the Lund AppleTalk network. Each new member of staff in 1993-94 expressed a preference for Apple (only the bright and creative work here...), and each new Mac was immediately put on the network.

A curious breakthrough was the purchase of a Macintosh Classic II, in 1993, "just for typing". It was little used, purely because everyone by then had access to something with a larger monitor. However, with System 7, even a Classic becomes a useful server, so "Plant Cell Nucleus" began as a 2 GB external hard drive on the Classic, which was on all the time, and where individuals could keep, leave, and receive files for joint projects. We also published, as a booklet, in early 1994, a first progress report, with details of publications, grants, seminars and so on. It seemed only sensible to divide the report into files and make them available on the Classic internally, and then, with FTPd running, as files accessible by ftp, since everyone was by then obtaining molecular biology information using Gopher. Apart from no hypertext, the ftp address ran into several lines and was impossible to remember

A seminar speaker, Lee McIntosh, from the Michigan State University, brought us news of Mosaic in late 1994, and it was immediately obvious that the web was the way to go, though less obvious how you do it. Eventually Allen contacted the Lund Computer Center Macintosh guru, Roland Månsson, who recommended MacHTTP. This ran happily on the Classic with its 4 MB RAM, and the Plant Cell Biology web site was born from the old gopher files in February 1996. The first external hit was from "deptmac.cse.ogi.edu" on February 22nd. No-one knows who this is, or where they got the URL.

The rest is upgrades, good advice, software, and Allen spending more time on the web site than he cares to admit. In particular, Lund's license agreement with Apple has always been really useful. The "Server" was in use more and more, and so in August 1996, we bought an Apple Internet Server 7250, which came with WebSTAR and BBEdit, among other fine things. The Classic, which had worked fine with virtual memory on (giving a mighty 8 MB) was getting a little slow, but never crashed. Really, could all this have ever started with an 1980s 386 PC? The heroic Classic was given a medal, and

moved into a lab where it is to this day happy collecting data from a spectrophotometer.

# Acknowledgement

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