

CyanoNews

---

1994

## CyanoNews (Vol. 10, No. 1, February 1994)

Jeff Elhai

*Virginia Commonwealth University*, [elhaij@vcu.edu](mailto:elhaij@vcu.edu)

Follow this and additional works at: <http://scholarscompass.vcu.edu/cyanonews>

 Part of the [Bacteriology Commons](#)

© The Author(s)

---

Downloaded from

<http://scholarscompass.vcu.edu/cyanonews/11>

This Bulletin is brought to you for free and open access by VCU Scholars Compass. It has been accepted for inclusion in CyanoNews by an authorized administrator of VCU Scholars Compass. For more information, please contact [libcompass@vcu.edu](mailto:libcompass@vcu.edu).

CYANONEWS

Volume 10 Number 1

February 1994

=====

CYANONEWS - a newsletter intended to provide cyanobacteriologists with a forum for rapid informal communication, unavailable through journals.

Everything

you read in this newsletter is contributed by readers like yourself.

Published occasionally, about three times per year.

SUBSCRIPTIONS - \$10 or equivalent/year for hard copy. E-mail version is free.

CONTRIBUTIONS - Expected every couple of years: a new result, an upcoming meeting or a summary of a past meeting, a post-doctoral opening, a new publication, a request for strains, a change of life... something. See last page for addresses you can send news to.

HOW TO FIND OUT MORE ABOUT SOMETHING YOU READ HERE - Look at the end of a news item for a contact person. Also, a Directory of Cyanobacteriologists is distributed every two years or on request.

INSTRUCTIONS TO AUTHORS - Send news.

COPYRIGHT - This newsletter is not copyrighted and no rights are reserved. You are encouraged to reproduce or to transmit any part of this publication by whatever means at your disposal, no permission required.

=====

CONTENTS\*CONTENTS\*CONTENTS\*CONTENTS\*CONTENTS\*CONTENTS\*CONTENTS\*CONTENTS\*CONTE

=====

BULLETIN BOARD:

- \* Meetings
- \* Monographs
- \* Positions available / sought
- \* Find strains fast... in the Microbial Germplasm Database

TRANSITIONS

- \* Comings and goings of ourselves

NEWS:

- \* Porin isolated from cyano outer membrane
- \* Zones of nitrogenase expression in trichomes of Trichodesmium
- \* High copy shuttle vector for Anabaena
- \* Computer models of energy transfer in C-phycocyanin complexes

REFERENCES

ADDRESSES

=====

BULLETIN BOARD\*BULLETIN BOARD\*BULLETIN BOARD\*BULLETIN BOARD\*BULLETIN BOARD\*B

=====

\*\*\*\*\* MEETINGS, PROCEEDINGS, AND MISCELLANY \*\*\*\*\*

The Fifth International PHYCOLOGICAL CONGRESS is to be held in Qingdao, P.R. China, 26 June to 2 July 1994. The congress will feature workshops on algal molecular biology, biodiversity, biogeography of freshwater algae, culture methodologies, and phycology and coastal management.

CONTACT: The Secretariat, EMBL, Institute of Oceanology, Chinese Academy of Sciences, 7 Nanhai Road, Qingdao, P.R. CHINA 266071

-----

A satellite workshop in Wuhan, P.R. China, 6-7 July will discuss the latest developments in MICROALGAL BIOLOGY AND BIOTECHNOLOGY and will be dedicated to the memory of the late Li Shanghao. The workshop immediately follows the Phycological Congress in Qingdao.

CONTACT: LIU Yong-Ding, Institute of Hydrobiology, The Chinese Academy of Sciences, Wuhan 430072, Hubei, P.R. CHINA. (Fax) 86-27-725132.

-----

A month of Chinese meetings will finish up with the Sixth International SYMPOSIUM ON SALINE LAKES, 14-19 July 1994, in Beijing, P.R. China. The

meeting will cover a wide range of topics, from geochemistry and mineralization to mineral effects on lake ecosystems and the impact of human activities on saline lake areas.

CONTACT: ZHENG Mianping or ZHANG Fasheng, Organizing Committee of 6th ISSL, Chinese Academy of Geological Sciences, Baiwanzhuang Road 26, Beijing 100037, P.R. CHINA. (Fax) 0086-1-8310894.

-----  
The Tenth International Conference on PHOTOCHEMICAL CONVERSION AND STORAGE OF SOLAR ENERGY will be held 24-29 July 1994 in Interlaken, Switzerland. This IPS conference will cover photosynthesis in biological and biomimetic systems as well as a variety of topics in photochemistry. The deadline for registration is March 31 and for abstracts February 28.

CONTACT: The IPS-10 Secretariat, Institute of Inorganic and Physical Chemistry, University of Berne, Freiestrasse 3, CH-3000 Berne 9, SWITZERLAND. (Tel) +41 31 631 42 36, (Fax) +41 31 631 39 94

-----  
To honor Philip Thornber on his retirement, there will be a conference entitled "STRUCTURE, FUNCTION AND BIOGENESIS OF CHLOROPHYLL-PROTEIN COMPLEXES", planned for 3-6 August 1994. The conference will be held at the University of California at Los Angeles and will focus on recent developments in the structural biology of chlorophyll-protein complexes from plants and bacteria as well as future research directions.

CONTACT: Richard Malkin, Department of Plant Biology, 111 Koshland Hall, University of California, Berkeley, CA 94720. (Tel) 510-642-5959, (Fax) 510-642-4995, (Email) DickM@Nature.Berkeley.Edu

-----  
Cyanobacteriologists world-wide will descend upon Urbino, Italy, 10-15 September 1994 for the VIII INTERNATIONAL SYMPOSIUM ON PHOTOTROPHIC PROKARYOTES. They (and, to be fair, purple- and green-afficionados as well) will focus on five themes: Biogenesis and regulation of the photosynthetic

apparatus, reaction centers and antenna, metabolism, ecology and taxonomy, and biochemical processes. In addition, a round table discussion is scheduled on the topic of "Basic and Applied Biotechnological Processes". A limited number of grants will be available for younger researchers and for students.

Applications will for support will be considered only by those presenting an abstract.

CONTACT: Organizing Secretariat of the VIII ISPP, S.Ventura, CNR-CSMA, p.le delle Cascine 27, I-50144 Firenze, ITALY. (Tel) +39-55-350542 or -352051, (Fax) +39-55-330431, (E-mail) Ventura@csma.fi.cnr.it

-----

The Sixth Conference of the AFRICAN ASSOCIATION FOR BIOLOGICAL NITROGEN FIXATION is scheduled for 12-17 September 1994 in Harare, Zimbabwe, focusing on the theme of agronomic, socio-economic, and environmental benefits of biological nitrogen-fixing systems in Africa. Registration is US\$150.

Financial assistance may be available for participants.

CONTACT: The Secretary, AABNF 6TH Conference, Department of Soil Science, University of Zimbabwe, Box MP 167, Mount Pleasant, Harare, Zimbabwe. (Tel) 263-4-303211 ext. 1412, (Telex) 26580 UNIVZ ZW, (Telegrams) UNIVERSITY, (Fax) 263-4-333407 or -335249 (E-mail) SMoyo@zimbix.uz.zw

-----

The PROCEEDINGS OF THE NATIONAL SEMINAR ON CYANOBACTERIAL RESEARCH - INDIAN SCENE, a collection of reports on the cyanobacterial research of laboratories throughout India, is available without charge.

CONTACT: G. Subramanian, National Facility for Marine Cyanobacteria, Bharathidasan niversity, Palkalaiperur, Tiruchirapalli 620 024, INDIA. (Tel) 0431-896-352, (Fax) 0431-96245, (Telex) 0455-253 BARD.

-----

CYANOBACTERIA have recently been seen center stage IN THE POPULAR MEDIA. In

the January 1994 issue of Scientific American [270(1):78-86], Wayne Carmichael presents for public inspection a review of toxic cyanobacteria, including a beautiful picture of a Microcystis bloom set against a garden in Beijing. In the same issue there is a special advertising section in which the Thai government puts its best scientific foot forward. Part of their best foot is a photograph, captioned "Cloning genes for biopesticides", that displays a table full of petri plates covered with (it appears) cyanobacteria.

-----

ENRIQUE FLORES points out that there is a conflict between the next European and American Cyanobacterial Workshops, both scheduled for about the same dates (May/June, 1995). The European Workshop is to be held in Sevilla, Spain, and the American Workshop in Asilomar, California. To avoid such conflicts now and in the future, Enrique proposes that each of the two workshops be held once every three years, to fit in between the Photosynthetic Prokaryote meetings. In concrete terms:

- 1991: Photosynthetic Prokaryotes, Amherst
- 1992: European Workshop, Bristol
- 1993: American Workshop, Asilomar
- 1994: Photosynthetic Prokaryotes, Urbino
- 1995: European Workshop, Sevilla  
or American Workshop, Asilomar
- 1996: American Workshop, Asilomar  
or European Workshop, Sevilla
- 1997: Photosynthetic Prokaryotes, ??

It is by no means too early to think about such things. Enrique would appreciate opinions on this proposal along with preferences as to which years would be most convenient for which meetings.

CONTACT: Enrique Flores, Instituto de Bioquímica Vegetal y Fotosíntesis,  
Universidad de Sevilla-CSIC, Apartado 1113,

41080 Sevilla SPAIN. (Tel) 954-61-70-11, (Fax) 34-5-462-0154,  
(E-mail) Flores@Cica.Es

-----  
Copies of the 1993 CYANOBACTERIA WORKSHOP ABSTRACT BOOKLET are available for  
the asking.

CONTACT: Jane Edwards, Carnegie Institution of Washington, 290 Panama  
Street, Stanford, CA 94305 U.S.A. (Tel) 415-325-1521 ext. 204,  
(Fax) 415-325-6857, (E-mail) jane@carnegie.stanford.edu

-----  
The Norwegian Institute for Water Research has made available a monograph  
entitled TAXONOMY OF TOXIC CYANOPHYCEAE (Cyanobacteria), by OM Skulberg, WW  
Carmichael, GA Codd, and R Skulberg, that surveys the toxic species and  
provides a practical guide for their identification.

CONTACT: Olav Skulberg, Norwegian Institute for Water Research, P.O.Box  
69 Korsvall, N-0808 Oslo 8 NORWAY

\*\*\*\*\* POSITIONS OFFERED AND SOUGHT \*\*\*\*\*

POSITION OFFERED: Post-Doc

CONTACT: Michael Seibert, National Renewable Energy Laboratory, Golden, CO  
80401-3393, U.S.A. (Tel) 303-384-6279, (Fax) 303-384-6150,  
(E-mail) Seibert@seri.nrel.gov

RESEARCH: Oxygen-evolution, electron donation, and photoactivation processes  
in PSII, using biochemical, spectroscopic, and electrochemical approaches  
with membrane/submembrane fractions obtained from plants and  
cyanobacterial  
mutants.

PERTINENT ARTICLES: Biochem (1991) 30:9615 and 30:9625; Research in  
Photosynthesis (1992), Murata N, ed., Vol II, p.357; Photosyn Res (1993)  
December issue.

SUPPORT: Salary highly competitive, for one year with possibility of extension.

SUBMIT: CV with list of publications; cover letter with statement of research interests; names, addresses, and telephone numbers of three professional references.

START: Immediately

-----  
POSITION SOUGHT: Postdoc in metal-toxicity or in nitrogen-fixation

APPLICANT: Srinivas Denduluri, Dept. of Biology, Memorial University, St. John's, Newfoundland, A1B 3X9 CANADA. (E-mail) DSrinivas@kean.ucs.mun.ca

EDUCATION and EXPERIENCE:

M.Sc. in cytogenetics

M.Phil. in microbiology ("Toxicity of lead and its interaction with chelating agents on some vegetable crops grown in sewage-irrigated soil")

Ph.D. (1st) in plant physiology and biochemistry ("Effects of lead, manganese, and chelating agents on some vegetable crops grown in sewage irrigated soil").

Ph.D. (2nd, thesis recently submitted) at Memorial University ("Role of lipid bodies in nitrogen-fixing nodules of Sesbania"). Experience also in nutrient cycling and related techniques, such as HPLC, gas chromatography, and isotopic methods.

PUBLICATIONS (selected; more available on request):

Srinivas D. (1993). Reduction of lead accumulation by ethylenediamine tetraacetic acid and nitrilo triacetic acid in okra grown in sewage irrigated soil. Bull Environ Cont Toxicol 51:40-45.

Bal AK, Srinivas D (1993). Catalase activity and biogenesis of microbodies in nitrogen-fixing root nodules of beach pea. Cell Biol Interntl (in



press).

Srinivas, D (1991) Dioecism in flowering plants: Causes and Evolution.

Biol

Edu 2:93-100.

\*\*\*\*\* FIND STRAINS FAST... IN THE MICROBIAL GERMLASM DATABASE \*\*\*\*\*

Microbial germplasm maintained in research-oriented laboratories in universities and experiment stations is a vast undocumented resource, one that is difficult to tap. The Microbial Germplasm Database (MGD) is designed to help you navigate through many of these collections in order to find what you want and how to obtain it. Microorganisms and genetic constructs covered by MGD include bacteria, viruses, fungi, various reproducible genetic elements, and nematodes. The germplasm documented in MGD is primarily used in research (botanical, biochemical, genetic, or agricultural) that is related to plants.

You can access MGD from your computer through the MGD Gopher, a menu-driven information port. If your local internet host is running Gopher software, simply type "gopher". Choose the "Other Gopher Servers" menu item, and then progressively home in on MGD by choosing: North America, United States, Oregon, and, finally, Microbial Germplasm Database. Alternatively, you can connect to MGD through the TELNET command, using the address bcc.orst.edu (the ip number is 128.193.86.4). Type mgd at the login prompt, and press the Enter key when asked for a password.

Besides putting the MGD database at your fingertips, the MGD Gopher also provides access to literature covering biodiversity, germplasm preservation, nitrogen fixation, biocontrol, and sustainable agriculture. The references can be searched by keyword, author, and title. Several other useful tools are

available, including a large collection of electronic phonebooks (some including E-mail addresses) for universities and organizations throughout the world.

The menus are pretty self-explanatory, and help files are available to guide you through them. MGD puts out a newsletter (hardcopy free) that describes the service and new features as they arise.

CONTACT: Joe Hanus, Microbial Germplasm Database, Dept. of Botany and Plant

Pathology, Oregon State University, Corvallis, OR 97331-2902, U.S.A.

(Tel) 503-737-5300, (Fax) 503-737-3573, (E-mail) HanusJ@ava.bcc.orst.edu

=====  
TRANSITIONS\*TRANSITIONS\*TRANSITIONS\*TRANSITIONS\*TRANSITIONS\*TRANSITIONS\*TRAN  
=====

JOHN BENEMANN continues his peripatetic ways. He's moved back to California from his previous base in Vero Beach, Florida (U.S.A.). He continues to consult on biotechnological applications of cyanobacteria.

343 Caravelle Drive, Walnut Creek CA 94598, U.S.A. (Tel/Fax) 510-939-5864

IGOR BROWN is temporarily absent from his bench in Odessa, Ukraine to visit the laboratory of Gunter Peschek until March 10, 1994.

c/o Gunter Peschek, Biophysical Chemistry Group, Institut fuer Physikal. Chemie, Universitaet Wien, Währinger Str. 42, A-1090 Wien, AUSTRIA  
(Fax) 011-43-1-3104597

YUPING CAI has left the safe confines of Michigan State University to begin a post-doc in the laboratory of Alex Glazer.

Department of Molecular and Cell Biology, 230 Stanley Hall, University of California, Berkeley CA 94720, U.S.A. (Tel) 510-2643-6302, (Fax) 510-643-9290.

MIROSLAV GANTAR has left Nigel Kirby's lab in Dundee to take a research position with Jeff Elhai.

Dept. of Biological Sciences, Florida International University, University Park, Miami FL 33199 U.S.A. (Tel) 305-348-4030 (Fax) 305-348-1986.

NIGEL KIRBY has also left Nigel Kirby's lab. He's abandoned academia to head research at the Scottish Crop Research Institute.

Mylnefield Research Services Ltd., Scottish Crop Research Institute, Invergowrie, Dundee DD2 5DA, Scotland, U.K. (Tel) 0382-562731, (Fax) 0382-562426

WOLFGANG LOCKAU has moved operations from Regensburg to his new home in Berlin.

Biochemie der Pflanzen, Fachbereich Biologie, Humboldt-Universitaet, Invalidenstr. 42, 10 115 Berlin, GERMANY

SEAN TURNER has moved from cold to wet, leaving University of Cincinnati for a warm new lab in Louisiana.

Department of Botany, Life Sciences Building, Louisiana State University, Baton Rouge LA 70803-1705, U.S.A. (Tel-lab) 504-388-8771, (Tel-office) 504-388-8494, (E-mail) BtTurn@LsuVax.Sncc.Lsu.Edu

PETER WOLK is visiting the lab of Nicole Tandeau de Marsac, returning to Michigan State University June, 1994.

Physiologie Microbienne, Institut Pasteur, 28 rue du Dr. Roux, 75724

=====

NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*NEWS\*

=====

\*\*\*\*\* PORIN ISOLATED FROM CYANO OUTER MEMBRANE \*\*\*\*\*

ALFRED HANSEL and others in Uwe Jørgens' lab have isolated and characterized a pore-forming protein (a porin) from the outer membrane of *Synechococcus* PCC 6301. The protein was purified under native conditions (using LDAO as detergent and anion exchange chromatography) the protein and migrated on SDS-PAGE at about 52 kD. Single channel conductance of 5.5 nS was observed when the protein was incorporated into black lipid bilayer. The protein is blocked at its N-terminus and has Phe-Thr-Phe at its C-terminus. Analysis of its amino acids showed that the protein is rather hydrophilic, which is atypical for membrane proteins, but typical for porins. The work will appear soon in Archives of Microbiology. Alfred is currently trying to clone the gene encoding the pore-forming protein in order to get information about the structure and regulation of porins in cyanobacteria.

Alfred Hansel, Institut für Biologie II/Mikrobiologie, Universität  
Freiburg, Schänzlestraße 1, D-79104 Freiburg GERMANY.

(Tel) 0761-2034542, (E-mail) Hansel@Sun1.Ruf.Uni-Freiburg.De

\*\*\*\*\* ZONES OF NITROGENASE EXPRESSION IN TRICHOMES OF TRICHODESMIUM \*\*\*\*\*

At one time, heterocystous cyanobacteria were thought to be the only cyanobacterial species capable of nitrogen fixation. In the past twenty-five years, however, several strains, both unicellular and filamentous, have been characterized that fix nitrogen without benefit of heterocysts. The question

of how these strains protect nitrogenase against inactivation by oxygen has been intensely studied [Fay P (1992) Microbiol Rev 56:340-373]. Many strains temporally separate the processes of nitrogen fixation and oxygenic photosynthesis. In one such filamentous strain, *Oscillatoria limosa*, nitrogenase appears to be distributed to all cells in the filament [Stal L & Bergman B (1990) Planta 182:287-291]. Nitrogenase is similarly distributed in *Plectonema boryanum* [Smoker J & Barnum SR (1990) 1st Eur Workshop Mol Biol Cyanobacteria], a strain that fixes nitrogen only under conditions of very low levels of ambient oxygen.

Nitrogen-fixing *Trichodesmium*, a group of marine planktonic cyanobacteria, is exceptional in a number of respects. Its filaments, though lacking heterocysts, can maintain nitrogen fixation against saturating levels of O<sub>2</sub> in seawater. Photosynthetically-produced oxygen is not avoided by temporal separation, since nitrogen fixation is suppressed by darkness or DCMU [Ohki K & Fujita Y (1988) Mar Biol 98:111-114]. Spatial separation of photosynthesis and nitrogen fixation in *Trichodesmium* was suggested twenty years ago by Carpenter and Price [(1976) Science 191:1278-1280], based on their observation that trichomes passing through the middle of a colony possessed a central zone of lightly pigmented cells that do not incorporate <sup>14</sup>C<sup>14</sup>O<sub>2</sub>. More recent attempts to localize nitrogenase by immunogold staining reported nitrogenase subunits in all cells of the filament [Paerl et al (1989) Appl Environ Microbiol 55:2965-2975; Ohki et al (1991) Proc 5th Symp Internat Prize Biol, eds. Mauchline J & Nemoto T, pp.205-216] or in a limited number of randomly distributed trichomes [Bergman B & Carpenter EJ (1991) J Phycol 27:158-165].

BIRGITTA BERGMAN and coworkers now focus the controversy with recent results from immunogold labeling of longitudinally sectioned trichomes of *Trichodesmium contortum*. Nitrogenase appeared to be limited to a zone of

consecutive cells central to the trichome. These cells, constituting about 10 to 15% of the total number within the trichome, are about half as long as those cells outside the zone. Although cells with nitrogenase appear paler by light microscopy, they contain immunologically reactive phycoerythrin in the same quantities as do cells outside of the zone. Their previous results [Bergman & Carpenter, op cit.] are not necessarily in conflict since the strain used in that study, *T. thiebautii*, has trichomes so twisted that it was not possible to cross-section more than a few cells in a row. Interestingly, the nitrogenase-containing cells of *T. thiebautii* contain a considerably higher than normal level of cytochrome oxidase [Bergman et al. (1993) Appl Environ Microbiol 59:3239-3244].

Does *Trichodesmium* possess a differentiated cell type similar in function to heterocysts but without the heterocyst's specialized cell envelope? Do different species of *Trichodesmium* possess different strategies of protecting nitrogenase from oxygen? Do zones of nitrogenase-laden cells appear in *Trichodesmium* in an analogous fashion as strings of proheterocysts in certain strains of *Anabaena* [Wilcox et al (1973) J Cell Sci 12:707-725]? Clearly there is no lack of interesting questions to answer!

Birgitta Bergman, Department of Botany, Stockholm University, S-106,  
Stockholm SWEDEN. (Tel) 46-8-16 37 51, (Fax) 46-8-16 55 25, (E-mail) Botanik@Botan.Su.Se

\*\*\*\*\* HIGH COPY SHUTTLE VECTOR FOR ANABAENA \*\*\*\*\*

Those of us who play with genes in *E. coli* would find it difficult to imagine life without high-copy-number plasmids such as pBR322, pUC18, and derivatives. Those of us who study *Anabaena* PCC 7120, however, have endured such a life working with our organism, having at our disposal only shuttle vectors (e.g., those based on the cyanobacterial plasmid pDU1) that replicate

in low copy in *Anabaena*. JIM GOLDEN tells us our suffering is over. His laboratory wanted a high-copy-number shuttle vector to facilitate isolation of shuttle vector plasmid DNA from *Anabaena* and to permit certain types of genetic manipulations, such as the titration of regulatory factors. Accordingly, they have isolated and sequenced a mutant pDU1 origin of replication that replicates at a higher copy number in *Anabaena*.

A high-copy-number mutation was obtained in the shuttle vector pCCB110 [Buikema WJ & Haselkorn R (1991). *Genes Dev* 5:321-330] by selection on neomycin at 100 ug/ml. Colonies containing high-copy-number plasmids were identified by a high yield of plasmid from heat lysis minipreps. The high-copy-number ori was trimmed down to a minimum size that still provided strong selection and stable maintenance in PCC 7120, and the resulting 3761-bp fragment was sequenced (GenBank accession L23221). The sequenced region is available as a SmaI fragment in pUC1819H3 (resulting in pAM1230) or pBluescript (resulting in pAM1231).

The original high-copy-number shuttle vector, pAM832, was trimmed down to produce pAM1011 and finally pAM1280. pAM1280 was modified to contain different multiple cloning sites (MCS) and the lacZ' gene fragment. The resulting plasmids, pAM1278 and pAM1279 (lacZ' MCS from pUC18 in both orientations) and pAM1281 and pAM1282 (lacZ' MCS from pBluescript II SK+ in both orientations), provide blue/white screening for inserts, and they have been tested for efficient transformation of *E. coli* and conjugation into *Anabaena* PCC 7120. The plasmids have not been fully characterized nor actually used yet for cloning experiments, but in test conjugations exconjugants could be easily selected for on plates containing neomycin at 50 ug/ml, which is double the concentration Jim's lab uses for other pDU1-based shuttle vectors.

Jim Golden, Department of Biology, Texas A&M University, College Station

TX 77843-3258 U.S.A. (Tel) 409-845-9823, (Fax) 409-845-2891,  
(E-mail) JGolden@Bio.Tamu.Edu

\*\*\*\*\* COMPUTER MODELS ENERGY TRANSFER IN C-PHYCOCYANIN COMPLEXES \*\*\*\*\*

ANDREY DEMIDOV along with Alexander Borisov report on computer simulations they have performed to assess the ability of different classes of models to reproduce the observed characteristics of energy transfer in C-phycoyanin (C-PC) complexes. They used two computational methods to simulate energy migration in C-PC fragments [Biophys J (1993) 64:1375-1384]. The first relied on a system of three differential equations, each describing the flow of energy amongst chromophores of the three types: alpha-84, beta-84, or beta-155. The second method relied on a Monte Carlo approach to simulate random walks of excitons between the chromophores. These approaches, using structural data from C-PC of *Agmenellum quadruplicatum*, enabled them to predict rates and channels of energy migration in the case of various C-PC aggregates and to evaluate the sensitivity of migration rates to the screw angle between adjoining trimers. By considering chromophores in random orientations or in the actual orientations found in C-PC, they were able to demonstrate that the actual orientations are nearly optimal for energy migration.

They used similar methods to determine the statistic of exciton jumps, finding that jump statistics can be described by the function:

$$F = C (t/\bar{t}) \exp(-t/\bar{t})$$

where C is a constant and t and  $\bar{t}$  are, respectively, the exciton localization (jump) time and its averaged value for the three chromophore types. Values of  $\bar{t}$  were calculated for various aggregates [Biofizika (1993)]



38:133-143].

They are now working on a new theory of calculation of fluorescence polarization degree and absorption anisotropy of molecular complexes with energy transfer. At present, they have examined C-PC beta-subunits and monomers and have derived generally useful formulae that can be used practically to calculate polarization data at steady-state and delta-pulse excitations in the cases of double- and triple-chromophore complexes. The theory considers light absorption and fluorescence by chromophores, energy transfer between them, and their mutual orientations. Chromophores within individual complexes are presumed to be rigidly positioned, and complexes are randomly distributed and oriented in space, with no energy transfer amongst them. The formulae take into account the angles between chromophore transition dipole moments in the individual molecular complex and contain parameters dependent upon chromophore spectroscopic features and rates of energy transfer.

Andrey, a physicist, is eager to receive any advice and help that you may care to proffer. He is particularly interested in raw material from C-PC aggregates of *A. quadruplicatum* and *Mastigocladus laminosus* to feed his model. He seeks, specifically: (a) fluorescence and absorption spectra, (b) emission and excitation spectra of polarized fluorescence, (c) absorption anisotropy spectra, (d) fluorescence depolarization and absorption anisotropy kinetics excited by picosecond pulses, and (e) chromophore fluorescence quantum yields.

Andrey Demidov, Physics Department, Moscow State University, 119899  
Moscow, RUSSIA. (E-mail) [Demidov@Demidov.Phys.Msu.Su](mailto:Demidov@Demidov.Phys.Msu.Su)

=====  
REFERENCES\*REFERENCES\*REFERENCES\*REFERENCES\*REFERENCES\*REFERENCES\*REFERENCE

\*\*\*\*\* EVOLUTION, SYSTEMATICS, and PROCHLOROPHYTES \*\*\*\*\*

- Kim E, Kim H, Hong SP, Kang KH, Kho YH, Park YH (1993). Gene Organization and Primary Structure of a Ribosomal RNA Gene Cluster from *Streptomyces griseus* subsp *griseus*. [Anacystis]. *Gene* 132:21-31.
- Martin W, Brinkmann H, Savonna C, Cerff R (1993). Evidence for a Chimeric Nature of Nuclear Genomes - Eubacterial Origin of Eukaryotic Glyceraldehyde-3-Phosphate Dehydrogenase Genes. *Proc Natl Acad Sci USA* 90:8692-8696.
- Sanangelatoni AM, Tiboni O (1993). The Chromosomal Location of Genes for Elongation Factor Tu and Ribosomal Protein-S10 in the Cyanobacterium *Spirulina platensis* Provides Clues to the Ancestral Organization of the *str* and *S10* Operons in Prokaryotes. *J Gen Microbiol* 139:2579-2584.
- Seckbach J, Ikan R, Ringelberg D, White D (1993). Sterols and Phylogeny of the Acidophilic Hot Springs Algae *Cyanidium caldarium* and *Galdieria sulphuraria*. *Phytochemistry* 34:1345-1349.
- Demuth J, Neve H, Witzel KP (1993). Direct Electron Microscopy Study on the Morphological Diversity of Bacteriophage Populations in Lake Plussee.[cyanobacteria]. *Appl Environ Microbiol* 59:3378-3384.
- Jensen TE (1993). A Morphometric Study of Natural and Laboratory Grown *Gloeotrichia* Species. *Microbios* 74(301):219-226.
- Shalapenok LS, Ilkevich YG (1993). Ultrastructural Characteristics of Chroococcoid Cyanobacteria Isolated from Black Sea Picoplankton. *Microbiology-Engl Tr* 62:99-104.
- Shalapenok LS, Shalapenok AA (1993). Special Features of Ultrastructure and Spectral Characteristics of Phycoerythrin of Black Sea Picocyanobacteria in Culture. *Microbiology-Engl Tr* 62:68-72.
- Wilson WH, Joint IR, Carr NG, Mann NH (1993). Isolation and Molecular Characterization of 5 Marine Cyanophages Propagated on *Synechococcus* Sp Strain WH7803. *Appl Environ Microbiol* 59:3736-3743.

Lockhart PJ, Penny D, Hendy MD, Larkum ADW (1993). Is *Prochlorothrix hollandica* the Best Choice as a Prokaryotic Model for Higher Plant Chl-a/b Photosynthesis. *Photosynth Res* 37:61-68.

\*\*\*\*\* ECOLOGY \*\*\*\*\*

Caumette P (1993). Ecology and Physiology of Phototrophic Bacteria and Sulfate-Reducing Bacteria in Marine Salterns.[cyanobacterial mats]. *Experientia* 49:473-481.

Guerrero R, Ashen J, Sole M, Margulis L (1993). *Spirosymplokos deltaeiberi* nov. gen., nov. sp. - Variable-Diameter Composite Spirochete from Microbial Mats. *Arch Microbiol* 160:461-470.

Howard A (1993). SCUM - Simulation of Cyanobacterial Underwater Movement. *Comput Appl Biosci* 9:413-419.

Kromkamp J, Limbeek M (1993). Effect of Short-Term Variation in Irradiance on Light Harvesting and Photosynthesis of the Marine Diatom *Skeletonema costatum* - A Laboratory Study Simulating Vertical Mixing.[Oscillatoria]. *J Gen Microbiol* 139:2277-2284.

Pinevich AV, Vepritskii AA, Gromov BV (1993). Biodiversity of Cyanobacteria (Foundations and Prospects, of Cognition and Preservation in Light of Ecological Problems in Russia). *Microbiology-Engl Tr* 62:253-261.

Waterbury JB, Valois FW (1993). Resistance to Co-occurring Phages Enables Marine *Synechococcus* Communities to Coexist with Cyanophages Abundant in Seawater. *Appl Environ Microbiol* 59:3393-3399.

Badger MR, Pfanz H, Budel B, Heber U, Lange OL (1993). Evidence for the Functioning of Photosynthetic CO<sub>2</sub>-Concentrating Mechanisms in Lichens Containing Green Algal and Cyanobacterial Photobionts. *Planta* 191:57-70.

Hur JS, Wellburn AR (1993). Effects of Atmospheric SO<sub>2</sub> on *Azolla* and *Anabaena* Symbiosis. *Physiol Plant* 88:65-72.

Palmqvist K (1993). Photosynthetic CO<sub>2</sub>-Use Efficiency in Lichens and Their

Isolated Photobionts - The Possible Role of a CO<sub>2</sub>-Concentrating Mechanism. *Planta* 191:48-56.

Sijderbiick E, Bergman B (1993). The Nostoc-Gunnera Symbiosis - Carbon Fixation and Translocation. *Physiol Plant* 89:125-132.

\*\*\*\*\* TOXINS and NATURAL SUBSTANCES \*\*\*\*\*

Carmichael WW (1994). Toxins of Cyanobacteria. *Sci Am* 270:78-86.

Choi BW, Namikoshi M, Sun FR, Rinehart KL, Carmichael WW, Kaup AM, Evans WR, Beasley VR (1993). Isolation of Linear Peptides Related to the Hepatotoxins Nodularin and Microcystins. *Tetrahedron Lett* 34:7881-7884.

Falch BS, Konig GM, Wright AD, Sticher O, Ruegger H, Bernardinelli G (1993). Ambigol a and B - New Biologically Active Polychlorinated Aromatic Compounds from the Terrestrial Blue-Green Alga *Fischerella ambigua*. *J Org Chem* 58:6570-6575.

Falconer IR (1993). Paralytic Shellfish Poisons from Freshwater Blue-Green Algae - Comment. *Med J Aust* 159:423.

Harada K, Mayumi T, Shimada T, Suzuki M, Kondo F, Watanabe MF (1993). Occurrence of Four Depsipeptides, Aeruginopeptins, Together with Microcystins from Toxic Cyanobacteria. *Tetrahedron Lett* 34:6091-6094.

Harada K, Nagai H, Kimura Y, Suzuki M, Park HD, Watanabe MF, Luukkainen R, Sivonen K, Carmichael WW (1993). Liquid Chromatography/Mass Spectrometric Detection of Anatoxin-a, a Neurotoxin from Cyanobacteria. *Tetrahedron* 49:9251-9260.

Herrmann WA, Kohlpaintner CW (1993). Water-Soluble Ligands, Metal Complexes, and Catalysts - Synergism of Homogeneous and Heterogeneous Catalysis. [Blue-green alga]. *Angew Chem Int Ed* 32:1524-1544.

Humpage AR, Rositano J, Baker PD, Nicholson BC, Steffensen DA (1993). Paralytic Shellfish Poisons from Freshwater Blue-Green Algae. *Med J Aust* 159:423.

James GD, Mills SD, Pattenden G (1993). Total Synthesis of Pukeleimide-A, a

- 5-ylidenepyrrol-2(5H)-one from Blue Green Algae. *J Chem Soc Perkin Trans* 1 NOV 7;(21):2581-2584.
- Kangatharalingam N, Priscu JC (1993). Isolation and Verification of Anatoxin-A Producing Clones of *Anabaena flos-aquae* (Lyngb) de Breb from a Eutrophic Lake. *FEMS Microbiol Ecol* 12:127-130.
- Kozhenkova EV, Bromov BV (1993). A biologically active compound from the blue-green alga *Calothrix intricata* Fritsch CALU 908. *Algologia* 3:23-27.
- Li Y, Llewellyn L, Moczydlowski E (1993). Biochemical and Immunochemical Comparison of Saxiphilin and Transferrin, Two Structurally Related Plasma Proteins from *Rana catesbeiana*. [Aphanizomenon]. *Mol Pharmacol* 44:742-748.
- Linton CJ, Wright SJL (1993). Volatile Organic Compounds - Microbiological Aspects and Some Technological Implications - Review. *J Appl Bacteriol* 75:1-12.
- Luukkainen R, Sivonen K, Namikoshi M, Fardig M, Rinehart KL, Niemela SI (1993). Isolation and Identification of 8 Microcystins from 13 *Oscillatoria agardhii* Strains and Structure of a New Microcystin. *Appl Environ Microbiol* 59:2204-2209.
- Martin C, Oberer L, Ino T, Konig WA, Busch M, Weckesser J (1993). Cyanopeptolins, New Depsipeptides from the Cyanobacterium *Microcystis* sp. PCC 7806. *J Antibiot* 46:1550-1556.
- Mori Y (1993). Synthesis of Acyclic 1, 3-Polyols and Its Application to Structural Study of Natural Products.[polymethoxy-1-alkenes from cyanobacteria]. *Yakugaku Zasshi-J Pharm Soc J* 113:438-453.
- Pattenden G, Thom SM (1993). Naturally Occurring Linear Fused Thiazoline-Thiazole Containing Metabolites - Total Synthesis of (-)-Didehydromirabazole-A, a Cytotoxic Alkaloid from Blue Green Algae. *J Chem Soc Perkin Trans I* JUL 21;(14):1629-1636.
- Patterson GML, Bolis CM (1993). Regulation of Scytonemin Accumulation in Cultures of *Scytonema ocellatum*. 1. Physical Factors. *Appl Microbiol*

- Biotechnol 40:375-381.
- Proteau PJ, Gerwick WH, Garciapichel F, Castenholz R (1993). The Structure of Scytonemin, an Ultraviolet Sunscreen Pigment from the Sheaths of Cyanobacteria. *Experientia* 49:825-829.
- Rudolphbohner S, Wu JT, Moroder L (1993). Identification and Characterization of Microcystin-LY from *Microcystis aeruginosa* (Strain-298). *Biol Chem Hoppe Seyler* 374:635-640.
- Schrader KK, Blevins WT (1993). Geosmin-Producing Species of *Streptomyces* and *Lyngbya* from Aquaculture Ponds. *Can J Microbiol* 39:834-840.
- Shirahashi H, Murakami N, Watanabe M, Nagatsu A, Sakakibara J, Tokuda H, Nishino H, Iwashima A (1993). Isolation and Identification of Anti-Tumor-Promoting Principles from the Fresh-Water Cyanobacterium *Phormidium tenue*. *Chem Pharm Bull Tokyo* 41:1664-1666.
- Sim ATR, Mudge LM (1993). Protein Phosphatase Activity in Cyanobacteria - Consequences for Microcystin Toxicity Analysis. *Toxicon* 31:1179-1186.
- Stocker A, Ruttimann A, Woggon WD (1993). Identification of the Tocopherol-Cyclase in the Blue-Green Algae *Anabaena variabilis* Kutzing (Cyanobacteria). *Helv Chim Acta* 76(4):1729-1738.
- Stotts RR, Namikoshi M, Haschek WM, Rinehart KL, Carmichael WW, Dahlem AM, Beasley VR (1993). Structural Modifications Imparting Reduced Toxicity in Microcystins from *Microcystis* spp. *Toxicon* 31:783-789.
- Tsukamoto S, Painuly P, Young KA, Yang XM, Shimizu Y, Cornell L (1993). Microcystilide-A - A Novel Cell-Differentiation-Promoting Depsipeptide from *Microcystis aeruginosa* NO-15-1840. *J Am Chem Soc* 115:11046-11047.
- Zotou A, Jefferies TM, Brough PA, Gallagher T (1993). Determination of Anatoxin-A and Homoanatoxin in Blue Green Algal Extracts by High-Performance Liquid Chromatography and Gas Chromatography Mass Spectrometry. *Analyst* 118:753-758.

\*\*\*\*\* TOXINS and NATURAL SUBSTANCES (Physiological Effects) \*\*\*\*\*

Aldridge WN (1993). The Esterases - Perspectives and Problems. *Chem Biol Interact* 87:5-13.

Andersen RJ, Luu HA, Chen DZX, Holmes CFB, Kent ML, Leblanc M, Taylor FJRM, Williams DE (1993). Chemical and Biological Evidence Links Microcystins to Salmon Netpen Liver Disease. *Toxicon* 31:1315-1323.

Baquet A, Gaussin V, Bollen M, Stalmans W, Hue L (1993). Mechanism of Activation of Liver Acetyl-CoA Carboxylase by Cell Swelling.[microcystin-LR]. *Eur J Biochem* 217:1083-1089.

Brandonisio O, Maggi P, Panaro MA, Marangi A, Marzio R, Angarano G (1993). A Cyanobacterium-like Body Found in the Stools of an HIV+ Patient with Diarrhoea. *Eur J Epidemiol* 9:453-454.

Connor BA, Shlim DR, Scholes JV, Rayburn JL, Reidy J, Rajah R (1993). Pathologic Changes in the Small Bowel in 9 Patients with Diarrhea Associated with a Coccidia-Like Body. *Ann Intern Med* 119:377-382.

Dosemeci A, Reese TS (1993). Inhibition of Endogenous Phosphatase in a Postsynaptic Density Fraction Allows Extensive Phosphorylation of the Major Postsynaptic Density Protein.[microcystin-LR]. *J Neurochem* 61:550-555.

Endean R, Monks SA, Griffith JK, Llewellyn LE (1993). Apparent Relationships Between Toxins Elaborated by the Cyanobacterium *Trichodesmium erythraeum* and Those Present in the Flesh of the Narrow-Barred Spanish Mackerel *Scomberomorus commersoni*. *Toxicon* 31:1155-1165.

Heyworth MF (1993). Cyanobacterium-Like Cyclospora Species. *N Engl J Med* 329:1505.

Hoge CW, Shlim DR, Echeverria P (1993). Cyanobacterium-Like Cyclospora Species. *N Engl J Med* 329:1504.

Holen I, Gordon PB, Seglen PO (1993). Inhibition of Hepatocytic Autophagy by Okadaic Acid and Other Protein Phosphatase Inhibitors.[Microcystin-LR]. *Eur J Biochem* 215:113-122.

- Holmes CFB, Boland MP (1993). Inhibitors of Protein Phosphatase-1 and Phosphatase-2A - Two of the Major Serine/Threonine Protein Phosphatases Involved in Cellular Regulation. *Curr Opin Struct Biol* 3:934-943.
- Mulkey RM, Herron CE, Malenka RC (1993). An Essential Role for Protein Phosphatases in Hippocampal Long-Term Depression. [Microcystin-LR]. *Science* 261:1051-1055.
- Oxenrider KA, Rasche ME, Thorsteinsson MV, Kennelly PJ (1993). Inhibition of an Archaeal Protein Phosphatase Activity by Okadaic Acid, Microcystin-LR, or Calyculin-A. *FEBS Lett* 331:291-295.
- Quinn RJ, Taylor C, Suganuma M, Fujiki H (1993). The Conserved Acid Binding Domain Model of Inhibitors of Protein Phosphatase-1 and Phosphatase-2A - Molecular Modelling Aspects. [Microcystin-LR]. *Bioorg Medicinal Chem Letter* 3:1029-1034.
- Runnegar MT, Kong SM, Berndt N (1993). Protein Phosphatase Inhibition and In vivo Hepatotoxicity of Microcystins. *Am J Physiol* 265(2 Part 1):G224-G230.
- Sterling CR, Ortega YR (1993). Cyanobacterium-Like Cyclospora Species - Reply. *N Engl J Med* 329:1505.
- Villard O, Himy R, Brogard C, Kremer M (1993). Cyanobacterium-Like Body-Associated Diarrhea. *Gastroenterol Clin Biol* 17:401-402.

\*\*\*\*\* PHYSIOLOGY and METABOLISM \*\*\*\*\*

- Buchholz BEE, Hayes PK, Walsby AE (1993). The Distribution of the Outer Gas Vesicle Protein, GvpC, on the Anabaena Gas Vesicle, and Its Ratio to GvpA. *J Gen Microbiol* 139:2353-2363.
- Donkor VA, Amewonor DHAK, Hader DP (1993). Effects of Tropical Solar Radiation on the Motility of Filamentous Cyanobacteria. *FEMS Microbiol Ecol* 12:143-148.
- Famiglietti M, Hochkoepler A, Luisi PL (1993). Surfactant-Induced Hydrogen Production in Cyanobacteria. *Biotechnol Bioeng* 42:1014-1018.



Geisler M, Richter J, Schumann J (1993). Molecular Cloning of a P-Type ATPase Gene from the Cyanobacterium *Synechocystis* sp. PCC 6803 - Homology to Eukaryotic Ca<sup>2+</sup>-ATPases. *J Mol Biol* 234:1284-1289.

Goncharova IV, Gerasimenko LM, Zavarzin GA, Ushatinskaya GT (1993). Formation of Mineral Phosphate Microtubes in the Presence of Halophilic Cyanobacterium *Microcoleus chthonoplastes*. *Curr Microbiol* 27:187-190.

Kataoka H, Watanabe M (1993). Negative Phototropism in *Vaucheria terrestris* Regulated by Calcium. 3. The Role of Calcium Characterized by Use of a High-Power Argon-Ion Laser as the Source of Unilateral Blue Light. [*Anabaena*]. *Plant Cell Physiol* 34:737-744.

Laboure AM, Briat JF (1993). Uptake of Iron from Ferric Citrate in the Cyanobacteria *Synechocystis* PCC6803. *C R Acad Sci [III]* 316:661-666.

Nagaya M, Aiba H, Mizuno T (1993). Cloning of a Sensory-Kinase-Encoding Gene That Belongs to the 2-Component Regulatory Family from the Cyanobacterium *Synechococcus* sp. PCC7942. *Gene* 131:119-124.

Nagaya M, Aiba H, Mizuno T (1993). A Cyanobacterial Gene Encoding a Protein with Extensive Homology to Mammalian Phosphoribosylpyrophosphate Synthetase. *Biosci Biotechnol Biochem* 57:1958-1959.

Ohmori K, Ohmori M (1993). Effect of cAMP on Cellular ATP Concentration in the Cyanobacterium *Spirulina platensis*. *J Gen Appl Microbiol Tokyo* 39:247-250.

Rendon JL, Mendoza-Hernandez G (1993). Effect of Inorganic Phosphate on the Self-Associating Properties of Glutathione Reductase from *Spirulina maxima*. *Biochem Mol Biol Int* 31:701-708.

Schlichting R, Bothe H (1993). The Cyanelles (Organelles of a Low Evolutionary Scale) Possess a Phosphate-Translocator and a Glucose-Carrier in *Cyanophora paradoxa*. *Bot Acta* 106:428-434.

Yamada N, Murakami N, Morimoto T, Sakakibara J (1993). Auto-Growth Inhibitory Substance from the Fresh-Water Cyanobacterium *Phormidium tenue*. *Chem Pharm Bull Tokyo* 41:1863-1865.

\*\*\*\*\* LIPIDS and ENVELOPE COMPONENTS \*\*\*\*\*

- Cohen Z, Reungjitchachawali M, Siangdung W, Tanticharoen M, Heimer YM (1993). Herbicide-Resistant Lines of Microalgae - Growth and Fatty Acid Composition. *Phytochemistry* 34:973-978.
- Filalimouhim R, Cornet JF, Fontaine T, Fournet B, Dubertret G (1993). Production, Isolation and Preliminary Characterization of the Exopolysaccharide of the Cyanobacterium *Spirulina platensis*. *Biotechnol Lett* 15:567-572.
- Gornicki P, Scappino LA, Haselkorn R (1993). Genes for 2 Subunits of Acetyl Coenzyme a Carboxylase of *Anabaena* Sp Strain PCC 7120 - Biotin Carboxylase and Biotin Carboxyl Carrier Protein. *J Bacteriol* 175:5268-5272.
- Hansel A, Schmid A, Tadros MH, Juergens UJ (1994). Isolation and characterization of porin from the outer membrane of *Synechococcus* PCC 6301. *Arch Microbiol* (in press).
- Higashi S, Murata N (1993). An In Vivo Study of Substrate Specificities of Acyl-Lipid Desaturases and Acyltransferases in Lipid Synthesis in *Synechocystis* PCC6803. *Plant Physiol* 102:1275-1278.
- Jones AL, Harwood JL (1993). Lipid Metabolism in the Brown Marine Algae *Fucus vesiculosus* and *Ascophyllum nodosum*. [*Anacystis nidulans*]. *J Exp Bot* 44:1203-1210.
- Kaya K, Sano T, Watanabe MM, Shiraishi F, Ito H (1993). Thioic-Acid Ester in Sulfolipid Isolated from Freshwater Picoplankton Cyanobacterium, *Synechococcus* Sp. *Biochim Biophys Acta* 1169:39-45.
- Murakami N, Shirahashi H, Nagatsu A, Sakakibara J (1993). Studies on Glycolipids. 6. New Acyl-Distributed Glyceroglycolipids from the Nitrogen-Fixing Cyanobacterium *Anabaena flos-aquae* f *flos-aquae*. *Chem Pharm Bull Tokyo* 41:1177-1179.
- Wada H, Avelangemacherel MH, Murata N (1993). The *desA* Gene of the

Cyanobacterium Synechocystis sp. Strain PCC6803 Is the Structural Gene for  $\Delta^5$ -12 Desaturase. J Bacteriol 175:6056-6058.

Wu QY, Yin S, Sheng GY, Fu JM (1993). Distribution and Comparison of Steranes from Blue-Green Algae Under Different Simulated Conditions. Sci China Ser B 36:872-879.

\*\*\*\*\* STRESS RESPONSES \*\*\*\*\*

Audholia S, Goyal D, Saxena RK (1993). Zinc Tolerance in Phormidium uncinatum. Folia Microbiol Prague 38(4):341-344.

Falkner G, Falkner R, Wagner F (1993). Adaptive Phosphate Uptake Behaviour of the Cyanobacterium Anacystis nidulans - Analysis by a Proportional Flow-Force Relation. C R Acad Sci [III] 316:784-787.

Panoff JM (1993). Control of a Locus That Is Required for Growth of Anabaena PCC7120 at Low Temperature. Curr Microbiol 27:273-276.

Scanlan DJ, Mann NH, Carr NG (1993). The Response of the Picoplanktonic Marine Cyanobacterium Synechococcus Species WH7803 to Phosphate Starvation Involves a Protein Homologous to the Periplasmic Phosphate-Binding Protein of Escherichia coli. Mol Microbiol 10:181-191.

Vigh L, Los DA, Horvath I, Murata N (1993). The Primary Signal in the Biological Perception of Temperature - Pd-Catalyzed Hydrogenation of Membrane Lipids Stimulated the Expression of the desA Gene in Synechocystis PCC6803. Proc Natl Acad Sci USA 90:9090-9094.

Visviki I, Rachlin JW (1994). Acute and Chronic Exposure of Dunaliella salina and Chlamydomonas bullosa to Copper and Cadmium - Effects on Ultrastructure. Arch Environ Contam Toxicol 26:154-162.

\*\*\*\*\* CIRCADIAN RHYTHM \*\*\*\*\*

Abarzua S, Altenburger R, Callies R, Grimme LH, Mayer A, Leibfritz D,

- Schiewer U (1993). Ammonium Rhythm in Cultures of the Cyanobacterium *Microcystis Firma*. *Physiol Plant* 89:659-663.
- Chen TH, Pen SY, Huang TC (1993). Induction of Nitrogen-Fixing Circadian Rhythm *Synechococcus RF-1* by Light Signals. *Plant Sci* 92:179-182.
- Hall JC, Rosbash M (1993). Oscillating Molecules and How They Move Circadian Clocks Across Evolutionary Boundaries. *Proc Natl Acad Sci USA* 90:5382-5383.
- Huang TC, Wang ST, Grobbelaar N (1993). Circadian Rhythm Mutants of the Prokaryotic *Synechococcus RF-1*. *Curr Microbiol* 27:249-254.
- Kondo T, Strayer CA, Kulkarni RD, Taylor W, Ishiura M, Golden SS, Johnson CH (1993). Circadian Rhythms in Prokaryotes - Luciferase as a Reporter of Circadian Gene Expression in Cyanobacteria. *Proc Natl Acad Sci USA* 90:5672-5676.

**\*\*NITROGEN METABOLISM, NITROGEN FIXATION, and HETEROCYST DIFFERENTIATION\*\***

- Cohenkupiec R, Gurevitz M, Zilberstein A (1993). Expression of *glnA* in the Cyanobacterium *Synechococcus Sp* Strain PCC 7942 Is Initiated from a Single *nif*-Like Promoter Under Various Nitrogen Conditions. *J Bacteriol* 175:7727-7731.
- Lara C, Rodriguez R, Guerrero MG (1993). Nitrate Transport in the Cyanobacterium *Anacystis nidulans*. *Physiol Plant* 89:582-587.
- Martinez J, Azam F (1993). Aminopeptidase Activity in Marine Chroococcoid Cyanobacteria. *Appl Environ Microbiol* 59:3701-3707.
- Paneque A, Munozcenteno MC, Ruiz MT, Cejudo FJ (1993). Nitrate Permease from *Azotobacter chroococcum*. [*Synechococcus*]. *Physiol Plant* 89:592-595.
- Schmidt J, Bubunenko M, Subramanian AR (1993). A Novel Operon Organization Involving the Genes for Chorismate Synthase (Aromatic Biosynthesis Pathway) and Ribosomal GTPase Center Proteins (L11, L1, L10, L12: *rplKAJL*) in Cyanobacterium *Synechocystis PCC 6803*. *J Biol Chem* 268:27447-27457.

- Singh S (1993). Role of Glutamine Synthetase, Glutamine and  $\text{NH}_4^+$  in the Regulation of  $\text{NO}_2^-$  Uptake in the Cyanobiont *Nostoc ANTH*. *J Plant Physiol* 142:403-406.
- Suzuki I, Sugiyama T, Omata T (1993). Primary Structure and Transcriptional Regulation of the Gene for Nitrite Reductase from the Cyanobacterium *Synechococcus* PCC 7942. *Plant Cell Physiol* 34:1311-1320.
- Watt DA, Amory AM, Cresswell CF (1993). Constitutive and Inducible Aspects of Nitrate-Nitrogen Uptake by *Chlamydomonas reinhardtii*. [*Synechococcus*]. *Physiol Plant* 89:507-511.
- Bauer CC, Scappino L, Haselkorn R (1993). Growth of the Cyanobacterium *Anabaena* on Molecular Nitrogen - *nifJ* Is Required When Iron Is Limited. *Proc Natl Acad Sci USA* 90:8812-8816.
- Bergman B, Siddiqui PJA, Carpenter EJ, Peschek GA (1993). Cytochrome Oxidase - Subcellular Distribution and Relationship to Nitrogenase Expression in the Nonheterocystous Marine Cyanobacterium *Trichodesmium thiebautii*. *Appl Environ Microbiol* 59:3239-3244.
- Singh HN, Chakravarty D, Rao KS, Singh AK (1993). Vanadium Requirement for Growth on  $\text{N}_2$  or Nitrate as Nitrogen Source in a Tungsten-Resistant Mutant of the Cyanobacterium *Nostoc-muscorum*. *J Basic Microbiol* 33(3):201-205.
- Thiel T (1993). Characterization of Genes for an Alternative Nitrogenase in the Cyanobacterium *Anabaena variabilis*. *J Bacteriol* 175:6276-6286.
- Troshina OY, Yakunin AF, Gogotov IN (1992). Growth and Activity of Nitrogen-Metabolism Enzymes in Free-Living Cultures of *Anabaena Azollae* and Its Mutants Resistant to Ethylenediamine. *Microbiology-Engl Tr* 61:706-710.
- Black TA, Cai YP, Wolk CP (1993). Spatial Expression and Autoregulation of *hetR*, a Gene Involved in the Control of Heterocyst Development in *Anabaena*. *Mol Microbiol* 9:77-84.
- Madan AP, Nierzwicki-Bauer SA (1993). In situ Detection of Transcripts for Ribulose-1,5-Bisphosphate Carboxylase in Cyanobacterial Heterocysts. *J*

Bacteriol 175:7301-7306.

Sarma TA, Khattar JIS (1993). Akinete Differentiation in Phototrophic, Photoheterotrophic and Chemoheterotrophic Conditions in *Anabaena torulosa*. *Folia Microbiol Prague* 38(4):335-340.

Wei TF, Ramasubramanian TS, Pu F, Golden JW (1993). *Anabaena* Sp Strain PCC 7120 *bifA* Gene Encoding a Sequence-Specific DNA-Binding Protein Cloned by *In vivo* Transcriptional Interference Selection. *J Bacteriol* 175:4025-4035.

Zhang CC (1993). A Gene Encoding a Protein Related to Eukaryotic Protein Kinases from the Filamentous Heterocystous Cyanobacterium *Anabaena* PCC 7120. *Proc Natl Acad Sci USA* 90:11840-11844.

\*\*\*\*\* CARBON METABOLISM \*\*\*\*\*

Amichay D, Levitz R, Gurevitz M (1993). Construction of a *Synechocystis* PCC6803 Mutant Suitable for the Study of Variant Hexadecameric Ribulose Bisphosphate Carboxylase Oxygenase Enzymes. *Plant Mol Biol* 23:465-476.

Badger MR, Schreiber U (1993). Effects of Inorganic Carbon Accumulation on Photosynthetic Oxygen Reduction and Cyclic Electron Flow in the Cyanobacterium *Synechococcus* PCC7942. *Photosynth Res* 37:177-191.

Friedberg D, Jager KM, Kessel M, Silman NJ, Bergman B (1993). Rubisco But Not Rubisco Activase Is Clustered in the Carboxysomes of the Cyanobacterium *Synechococcus* sp. PCC 7942 - Mud-Induced Carboxysomeless Mutants. *Mol Microbiol* 9:1193-1201.

Hubbs AE, Roy H (1993). Assembly of *In vitro* Synthesized Large Subunits into Ribulose-Bisphosphate Carboxylase/Oxygenase - Formation and Discharge of an L8-Like Species. *J Biol Chem* 268:13519-13525.

Lee GJ, Kostov RV, McFadden BA (1993). A facile method to determine the CO<sub>2</sub>/O<sub>2</sub> specificity factor for ribulose biphosphate carboxylase/oxygenase. *Photosyn Res* 37:81-86.

Lee GJ, McDonald KA, Mcfadden BA (1993). Leucine-332 Influences the CO<sub>2</sub>/O<sub>2</sub>

- Specificity Factor of Ribulose-1, 5-Bisphosphate Carboxylase Oxygenase from *Anacystis nidulans*. *Protein Sci* 2:1147-1154.
- Newman J, Gutteridge S (1993). The X-Ray Structure of *Synechococcus* Ribulose-Bisphosphate Carboxylase/Oxygenase-Activated Quaternary Complex at 2.2-angstrom Resolution. *J Biol Chem* 268:25876-25886.
- Paul K, Morell MK, Andrews TJ (1993). Amino-Terminal Truncations of the Ribulose-Bisphosphate Carboxylase Small Subunit Influence Catalysis and Subunit Interactions. *Plant Physiol* 102:1129-1137.
- Shiraiwa Y, Goyal A, Tolbert NE (1993). Alkalization of the Medium by Unicellular Green Algae During Uptake of Dissolved Inorganic Carbon. *Plant Cell Physiol* 34:649-657.
- Sultemeyer D, Schmidt C, Fock HP (1993). Carbonic Anhydrases in Higher Plants and Aquatic Microorganisms. *Physiol Plant* 88:179-190.
- Turpin DH (1993). Phytoplankton Growth and CO<sub>2</sub>. *Nature* 363:678.
- Williams TG, Colman B (1993). Identification of Distinct Internal and External Isozymes of Carbonic Anhydrase in *Chlorella saccharophila*. [*Synechococcus*]. *Plant Physiol* 103:943-948.

\*\*\*\*\* PHOTOSYNTHESIS \*\*\*\*\*

- Frackowiak D, Skibinski A, Zelent B, Leblanc RM (1993). Study of Energy Transfer in the Antenna System Isolated from *Mastigocladus laminosus* Cohn. *Biochem Biophys Res Commun* 197:28-33.
- Govindjee, Snel JFH, Devos OJ, Vanransen JJS (1993). Antagonistic Effects of Light-I and Light-II on Chlorophyll-A Fluorescence Yield and P700 Turnover as Monitors of Carbon Dioxide Depletion in Intact Algal and Cyanobacterial Cells. *Physiol Plant* 89:143-148.
- Komenda J, Masojidek J, Bocek J, Prasil O (1993). Reversible and irreversible changes of fluorescence parameters during photoinhibition in the *Synechococcus elongatus* cells. *Photosynthetica* 28:249-251.

- Lu R-Z, Liu B (1993). Fluorescence emission, energy transfer and structure of phycobilisomes from *Nostoc flagelliforme* Born. et Flah. during dissociation. *Photosynthetica* 28:253-258.
- Miki K, Tamada T, Nishida H, Inaka K, Yasui A, Deruiter PE, Eker APM (1993). Crystallization and Preliminary X-Ray Diffraction Studies of Photolyase (Photoreactivating Enzyme) from the Cyanobacterium *Anacystis nidulans*. *J Mol Biol* 233:167-169.
- Misra HS, Tuli R (1993). Photosystem II Independent Carbon Dioxide Fixation in *Plectonema boryanum* During Photoautotrophic Growth Under Nitrogen Fixation Conditions. *J Plant Biochem Biotechnol* 2:101-104.
- Murakami A, Fujita Y (1993). Regulation of Stoichiometry Between PSI and PSII in Response to Light Regime for Photosynthesis Observed with *Synechocystis* PCC 6714 - Relationship Between Redox State of Cyt b6-F Complex and Regulation of PSI Formation. *Plant Cell Physiol* 34:1175-1180.
- Murthy SDS, Mohanty P (1993). Mercury Ions Inhibit Photosynthetic Electron Transport at Multiple Sites in the Cyanobacterium *Synechococcus*-6301. *J Biosciences* 18:355-360.
- Oquist G, Hurry VM, Huner NPA (1993). The Temperature Dependence of the Redox State of QA and Susceptibility of Photosynthesis to Photoinhibition. *Plant Physiol Biochem* 31:683-691.
- Ploug H, Lassen C, Jorgensen BB (1993). Action Spectra of Microalgal Photosynthesis and Depth Distribution of Spectral Scalar Irradiance in a Coastal Marine Sediment of Limfjorden, Denmark. *FEMS Microbiol Ecol* 12:69-78.
- Post AF, Ohad I, Warner KM, Bullerjahn GS (1993). Energy Distribution Between Photosystem I and Photosystem II in the Photosynthetic Prokaryote *Prochlorothrix-hollandica* Involves a Chlorophyll-a/b Antenna Which Associates with Photosystem I. *Biochim Biophys Acta* 1144:374-384.
- Reuter W, Muller C (1993). Adaptation of the Photosynthetic Apparatus of Cyanobacteria to Light and CO<sub>2</sub>. *J Photochem Photobiol B-Biol* 21:3-27.



Shyam R, Raghavendra AS, Sane PV (1993). Role of Dark Respiration in Photoinhibition of Photosynthesis and Its Reactivation in the Cyanobacterium *Anacystis nidulans*. *Physiol Plant* 88:446-452.

Smith D, Howe CJ (1993). The Distribution of Photosystem I and Photosystem II Polypeptides Between the Cytoplasmic and Thylakoid Membranes of Cyanobacteria. *FEMS Microbiol Lett* 110:341-347.

\*\*\*\*\* PHOTOSYSTEM I \*\*\*\*\*

Cohen Y, Chitnis VP, Nechushtai R, Chitnis PR (1993). Stable Assembly of PsaE into Cyanobacterial Photosynthetic Membranes Is Dependent on the Presence of Other Accessory Subunits of Photosystem I. *Plant Mol Biol* 23:895-900.

Fork DC, Herbert SK (1993). Electron Transport and Photophosphorylation by Photosystem I In vivo in Plants and Cyanobacteria. *Photosynth Res* 36:149-168.

Golbeck JH (1993). The Structure of Photosystem I. *Curr Opin Struct Biol* 3:508-514.

Holzwarth AR, Schatz G, Brock H, Bittersmann E (1993). Energy Transfer and Charge Separation Kinetics in Photosystem I. 1. Picosecond Transient Absorption and Fluorescence Study of Cyanobacterial Photosystem I Particles. *Biophys J* 64:1813-1826.

Ikegami I, Itoh S, Warren PG, Golbeck JH (1993). Reconstitution of the Photosystem I Secondary Quinone Acceptor (A1) in the P700-F(X) Core Isolated from *Synechococcus* PCC 6301. *Plant Cell Physiol* 34:849-853.

Kaurov YN, Aksyonova GE, Lovyagina ER, Veselova TV, Ivanov II (1993). Thermally-Induced Delayed Luminescence from PS I in Membranes of Thermophilic Cyanobacteria. *Biochim Biophys Acta* 1143:97-103.

Kruip J, Boekema EJ, Bald D, Boonstra AF, Rogner M (1993). Isolation and Structural Characterization of Monomeric and Trimeric Photosystem I

- Complexes (P700-FA/FB and P700-FX) from the Cyanobacterium *Synechocystis* PCC 6803. *J Biol Chem* 268:23353-23360.
- Lockau W, Nitschke W (1993). Photosystem I and Its Bacterial Counterparts. *Physiol Plant* 88:372-381.
- Maeda H, Watanabe T, Sonoike K (1993). Chemical Environment Heterogeneity Around the 2 Chlorophyll-a' Molecules in Photosystem I. *J Photochem Photobiol B-Biol* 20:139-143.
- Nyhus KJ, Thiel T, Pakrasi HB (1993). Targeted interruption of the *psaA* and *psaB* genes encoding the reaction-centre proteins of Photosystem I in the filamentous cyanobacterium *Anabaena variabilis* ATCC 29413. *Molec Microbiol* 9:979-988.
- Nyhus KJ, Thiel T, Pakrasi HB (1993). Targeted Interruption of the *psaA* and *psaB* Genes Encoding the Reaction-Centre Proteins of Photosystem I in the Filamentous Cyanobacterium *Anabaena variabilis* ATCC-29413. *Mol Microbiol* 9:979-988.
- Obokata J, Mikami K, Hayashida N, Nakamura M, Sugiura M (1993). Molecular Heterogeneity of Photosystem I - *psaD*, *psaE*, *psaF*, *psaH*, and *psaL* Are All Present in Isoforms in *Nicotiana* spp.[*Synechocystis* PCC6803]. *Plant Physiol* 102:1259-1267.
- Prisner TF, McDermott AE, Un S, Norris JR, Thurnauer MC, Griffin RG (1993). Measurement of the g-tensor of the P700+ - Signal from Deuterated Cyanobacterial Photosystem I Particles. *Proc Natl Acad Sci USA* 90:9485-9488.
- Shubin VV, Tsuprun VL, Bezsmertnaya IN, Karapetyan NV (1993). Trimeric Forms of the Photosystem I Reaction Center Complex Pre-Exist in the Membranes of the Cyanobacterium *Spirulina platensis*. *FEBS Lett* 334:79-82.
- Weber N, Strotmann H (1993). On the Function of Subunit-PsaE in Chloroplast Photosystem I. *Biochim Biophys Acta* 1143:204-210.
- Yu L, Zhao JD, Muhlenhoff U, Bryant DA, Golbeck JH (1993). PsaE Is Required for In Vivo Cyclic Electron Flow Around Photosystem I in the

Cyanobacterium *Synechococcus* Sp-PCC 7002. *Plant Physiol* 103:171-180.

Zhao J, Snyder WB, Muhlenhoff U, Rhiel E, Warren PV, Golbeck JH, Bryant DA (1993). Cloning and Characterization of the *psaE* Gene of the Cyanobacterium *Synechococcus* Sp PCC 7002 - Characterization of a *psaE* Mutant and Overproduction of the Protein in *Escherichia coli*. *Mol Microbiol* 9:183-194.

\*\*\*\*\* PHOTOSYSTEM II \*\*\*\*\*

[Proceedings] (1993). FESPP Workshop on the Environmental Factors Affecting Photosystem 2 (Szeged, 1992). *Photosynthetica* 28:162-288.

Boerner RJ, Barry BA (1993). Isotopic labeling and EPR spectroscopy show that a tyrosine residue is the terminal electron donor, Z, in manganese-depleted photosystem II preparations. *J Biol Chem* 268:17151-.

Carpenter SD, Ohad I, Vermaas WFJ (1993). Analysis of Chimeric Spinach/Cyanobacterial CP43 Mutants of *Synechocystis* sp. PCC 6803 - The Chlorophyll-Protein CP43 Affects the Water-Splitting System of Photosystem II. *Biochim Biophys Acta* 1144:204-212.

Clarke AK, Hurry VM, Gustafsson P, Oquist G (1993). Two Functionally Distinct Forms of the Photosystem II Reaction-Center Protein D1 in the Cyanobacterium *Synechococcus* sp. PCC 7942. *Proc Natl Acad Sci USA* 90:11985-11989.

Clarke AK, Soitamo A, Gustafsson P, Oquist G (1993). Rapid Interchange Between Two Distinct Forms of Cyanobacterial Photosystem II Reaction-Center Protein-D1 in Response to Photoinhibition. *Proc Natl Acad Sci USA* 90:9973-9977.

Eggers B, Vermaas W (1993). Truncation of the D2 Protein in *Synechocystis* sp. PCC 6803 - A Role of the C-Terminal Domain of D2 in Photosystem II Function and Stability. *Biochemistry* 32:11419-11427.

Elanskaya IV, Brown MN, Gadziev AG, Shestakov SV (1993). Mutational

- Analysis of the Genes Encoding the Photosystem II Proteins in  
Cyanobacterium *Synechocystis* sp. 6803. *Genetika* 29:1620-1629.
- Ermakova SY, Elanskaya IV, Kallies KU, Weihe A, Birkner T, Shestakov SV  
(1993). Cloning and Sequencing of Mutant *psbB* Genes of the  
Cyanobacterium *Synechocystis* PCC 6803. *Photosynth Res* 37:139-146.
- Fotinou C, Kokkinidis M, Fritzsche G, Haase W, Michel H, Ghanotakis DF  
(1993). Characterization of a Photosystem II Core and Its 3-Dimensional  
Crystals. *Photosynth Res* 37:41-48.
- Han K, Katoh S (1993). Different Localization of 2 Ca<sup>2+</sup> in Spinach  
Oxygen-Evolving Photosystem II Membranes - Evidence for Involvement of  
Only One Ca<sup>2+</sup> in Oxygen Evolution.[*Synechococcus*]. *Plant Cell Physiol*  
34:585-593.
- Johnson CH, Schmidt GW (1993). The *psbB* Gene Cluster of the *Chlamydomonas*  
*reinhardtii* Chloroplast - Sequence and Transcriptional Analyses of *psbN*  
and *psbH*. *Plant Mol Biol* 22:645-658.
- Kloos R, Stevens E, Oettmeier W (1993). Complete Sequence of One Copy of  
the *psba* Gene from the Thermophilic Cyanobacterium *Synechococcus*  
*Elongatus*. *Z Naturforsch C* 48:799-802.
- Kretschmann H, Witt HT (1993). Chemical Reduction of the Water Splitting  
Enzyme System of Photosynthesis and Its Light-Induced Reoxidation  
Characterized by Optical and Mass Spectrometric Measurements. *Biochim*  
*Biophys Acta* 1144:331-345.
- Kuhn MG, Vermaas WFJ (1993). Deletion Mutations in a Long Hydrophilic Loop  
in the Photosystem II Chlorophyll-Binding Protein CP43 in the  
Cyanobacterium *Synechocystis* Sp PCC6803. *Plant Mol Biol* 23:123-133.
- Kulkarni RD, Mueller UW, Golden SS (1993). Nucleotide Sequence of *psbB* from  
*Synechococcus* Sp Strain PCC 7942. *Biochim Biophys Acta* 1173:329-332.
- Li RX, Golden SS (1993). Enhancer Activity of Light-Responsive Regulatory  
Elements in the Untranslated Leader Regions of Cyanobacterial *psbA*  
Genes. *Proc Natl Acad Sci USA* 90:11678-11682.
- Mannan RM, Pakrasi HB (1993). Dark Heterotrophic Growth Conditions Result

- in an Increase in the Content of Photosystem II Units in the Filamentous Cyanobacterium *Anabaena variabilis* ATCC 29413. *Plant Physiol* 103:971-977.
- Mayes SR, Dallachiesa M, Zhang ZH, Barber J (1993). The Genes *aroA* and *trnQ* Are Located Upstream of *psbO* in the Chromosome of *Synechocystis* 6803. *FEBS Lett* 325:255-261. Correction 327:123.
- Meunier PC, Bendall DS (1993). On the Rates of Cyclic Electron Transport Around Photosystem II in the Presence of Donor Side Limitation. *Photosynth Res* 37:147-158.
- Misra HS, Desai TS (1993). Involvement of Acceptor Side Components of PSII in the Regulatory Mechanism of *Plectonema boryanum* Grown Photoautotrophically Under Diazotrophic Condition. *Biochem Biophys Res Commun* 194:1001. Correction 197:350.
- Mohanty P, Hayashi H, Papageorgiou GC, Murata N (1993). Stabilization of the Mn-cluster of the oxygen-evolving complex by glycinebetaine. *Biochim Biophys Acta* 1144:92-.
- Pistorius EK (1993). The Identity of the Water Oxidizing Enzyme in Photosystem II Is Still Controversial. *Physiol Plant* 87:624-631.
- Ponticos M, Shipton CA, de las Rivas J, Barber J (1993). Two D1 protein degradation patterns in isolated photosystem 2 core and reaction centre complexes. *Photosynthetica* 28:215-224.
- Shen JR, Inoue Y (1993). Cellular Localization of Cytochrome *c550* - Its Specific Association with Cyanobacterial Photosystem II. *J Biol Chem* 268:20408-20413.
- Singh DP, Sharma SK, Bisen PS (1993). Differential Action of  $Hg^{2+}$  and  $Cd^{2+}$  on the Phycobilisomes and Chlorophyll-a Fluorescence, and Photosystem II Dependent Electron Transport in the Cyanobacterium *Anabaena flos-aquae*. *Biometals* 6:125-132.
- Styring S, Davidsson L, Tommos C, Vermaas W, Vass I, Svensson B (1993). Structure of redox components in Photosystem 2 studied with computer

modelling, site-directed mutagenesis and EPR spectroscopy.

Photosynthetica 28:225-241.

Tang XS, Chisholm DA, Dismukes GC, Brudvig GW, Diner BA (1993).

Spectroscopic Evidence from Site-Directed Mutants of *Synechocystis* PCC6803 in Favor of a Close Interaction Between Histidine-189 and Redox-Active Tyrosine-1608 Both of Polypeptide D2 of the Photosystem II Reaction Center. *Biochemistry* 32:13742-13748.

\*\*\*\*\* PHYCOBILISOMES and PIGMENTS \*\*\*\*\*

Apt KE, Hoffman NE, Grossman AR (1993). The gamma-Subunit of R-phycoerythrin and Its Possible Mode of Transport into the Plastid of Red Algae. *J Biol Chem* 268:16208-16215.

Betz M, Rueggeger U, Esteban AM, Sidler WA, Zuber H (1993). Reconstitution of the Core Complex ( $\alpha$ - $\beta$ )<sub>3</sub>APC LC8.9 of the Phycobilisome from *Mastigocladus laminosus* Using the LC8.9 Linker Polypeptide Overexpressed in *Escherichia coli*. *Biol Chem Hoppe Seyler* 374:435-443.

Demidov AA, Borisov AYu (1993). Computer Simulation of Energy Migration in the C-Phycocyanin of the Blue-Green Algae *Agmenellum quadruplicatum*. *Biophys J* 64:1375-1384.

Demidov AA, Borisov AYu (1993). Numerical Modeling of Energy Migration in C-Phycocyanin of the Blue-Green Alga *Agmenellum quadruplicatum*. *Biofizika* 38:133-143.

Dubbs JM, Bryant DA (1993). Organization and Transcription of the Genes Encoding 2 Differentially Expressed Phycocyanins in the Cyanobacterium *Pseudanabaena* Sp PCC 7409. *Photosynth Res* 36:169-183.

Erokhina LG (1992). Spectral Effects of Chromatic Adaptation of Nitrogen-Fixing Cyanobacteria Growing on Different Nitrogen Sources. *Microbiology-Engl Tr* 61:673-679.

Ficner R, Huber R (1993). Refined Crystal Structure of Phycoerythrin from *Porphyridium cruentum* at 0.23-nm Resolution and Localization of the

- gamma Subunit. *Eur J Biochem* 218:103-106.
- Gottschalk L, Lottspeich F, Scheer H (1993). Reconstitution of Allophycocyanin from *Mastigocladus laminosus* with Isolated Linker Polypeptide. *Photochem Photobiol* 58:761-767.
- Grossman AR, Schaefer MR, Chiang GG, Collier JL (1993). The Phycobilisome, a Light-Harvesting Complex Responsive to Environmental Conditions. *Microbiol Rev* 57:725-749.
- Hong Q, Zhao KH, Scheer H (1993). Two Different Types of Photochemistry in Phycoerythrocyanin alpha-Subunit. *Photochem Photobiol* 58:745-747.
- Patnaik J, Swain N, Adhikary SP (1993). Differential Response of Two Species of the Cyanobacterium *Anabaena* to Ultraviolet (UV-C) Irradiation. *J Basic Microbiol* 33(6):427-432.
- Thomas BA, Bricker TM, Klotz AV (1993). Post-Translational Methylation of Phycobilisomes and Oxygen Evolution Efficiency in Cyanobacteria. *Biochim Biophys Acta* 1143:104-108.
- Xia AD, Zhu JC, Wu HJ, Jiang LJ, Zhang XY, Sudha M, Sai PSM (1993). Time-Resolved Polarized Absorption of C-Phycocyanin from the Cyanobacterium *Westiellopsis prolifica*. *J Photochem Photobiol B-Biol* 19:111-117.
- Burnap RL, Troyan T, Sherman LA (1993). The Highly Abundant Chlorophyll-Protein Complex of Iron-Deficient *Synechococcus* Sp PCC7942 (CP43) Is Encoded by the *isiA* Gene. *Plant Physiol* 103:893-902.
- Chamovitz D, Sandmann G, Hirschberg J (1993). Molecular and Biochemical Characterization of Herbicide-Resistant Mutants of Cyanobacteria Reveals That Phytoene Desaturation Is a Rate-Limiting Step in Carotenoid Biosynthesis. *J Biol Chem* 268:17348-17353.
- Cunningham FX, Chamovitz D, Misawa N, Gantt E, Hirschberg J (1993). Cloning and Functional Expression in *Escherichia coli* of a Cyanobacterial Gene for Lycopene Cyclase, the Enzyme That Catalyzes the Biosynthesis of beta-Carotene. *FEBS Lett* 328:130-138.

- Hinterstoisser B, Cichna M, Kuntner O, Peschek GA (1993). Cooperation of Plasma and Thylakoid Membranes for the Biosynthesis of Chlorophyll in Cyanobacteria - The Role of the Thylakoid Centers. *J Plant Physiol* 142:407-413.
- Linden H, Lucas MM, Defelipe MR, Sandmann G (1993). Immunogold Localization of Phytoene Desaturase in Higher Plant Chloroplasts.[*Synechococcus*]. *Physiol Plant* 88:229-236.
- Tyacke RJ, Harwood JL, John RA (1993). Properties of the Pyridoxalimine Form of Glutamate Semialdehyde Aminotransferase (glutamate-1-semialdehyde 2, 1-aminomutase) and Analysis of Its Role as an Intermediate in the Formation of Aminolaevulinate.[*Synechococcus*]. *Biochem J* 293:697-701.

\*\*\*\*\* ELECTRON TRANSPORT and BIOENERGETICS \*\*\*\*\*

- Berger S, Ellersiek U, Kinzelt D, Steinmuller K (1993). Immunopurification of a Subcomplex of the NAD(P)H-Plastoquinone-Oxidoreductase from the Cyanobacterium *Synechocystis* Sp PCC6803. *FEBS Lett* 326:246-250. Correction 330:110.
- Fillat MF, Flores E, Gomez-Moreno C (1993). Homology of the N-Terminal Domain of the petH Gene Product from *Anabaena* Sp PCC 7119 to the CpcD Phycobilisome Linker Polypeptide. *Plant Mol Biol* 22:725-729.
- Sone N, Tano H, Ishizuka M (1993). The Genes in the Thermophilic Cyanobacterium *Synechococcus vulcanus* Encoding Cytochrome c Oxidase. *Biochim Biophys Acta* 1183:130-138.
- Tollin G, Hurley JK, Hazzard JT, Meyer TE (1993). Use of Laser Flash Photolysis Time-Resolved Spectrophotometry to Investigate Interprotein and Intraprotein Electron Transfer Mechanisms.[*Anabaena*]. *Biophys Chem* 48:259-279.
- Bovy A, Dekruif J, Devrieze G, Borrias M, Weisbeek P (1993). Iron-Dependent Protection of the *Synechococcus* Ferredoxin-I Transcript Against



- Nucleolytic Degradation Requires Cis-Regulatory Sequences in the 5' Part of the Messenger RNA. *Plant Mol Biol* 22:1047-1065.
- Gisselmann G, Klausmeier P, Schwenn JD (1993). The ferredoxin:sulphite reductase gene from *Synechococcus* PCC7942. *Biochim Biophys Acta* 1144:102-.
- Hurley JK, Cheng H, Xia B, Markley JL, Medina M, Gomez-Moreno C, Tollin G (1993). An Aromatic Amino Acid Is Required at Position-65 in *Anabaena* Ferredoxin for Rapid Electron Transfer to Ferredoxin:NADP+ Reductase. *J Am Chem Soc* 115:11698-11701.
- Hurley JK, Salamon Z, Meyer TE, Fitch JC, Cusanovich MA, Markley JL, Cheng H, Xia B, Chae YK, Medina M, Gomez-Moreno C, Tollin G (1993). Amino Acid Residues in *Anabaena* Ferredoxin Crucial to Interaction with Ferredoxin NADP+ Reductase - Site-Directed Mutagenesis and Laser Flash Photolysis. *Biochemistry* 32:9346-9354.
- Jacobson BL, Chae YK, Markley JL, Rayment I, Holden HM (1993). Molecular Structure of the Oxidized, Recombinant, Heterocyst [2Fe-2S] Ferredoxin from *Anabaena*-7120 Determined to 1.7-Angstrom Resolution. *Biochemistry* 32:6788-6793.
- Lloyd E, Tomkinson NP, Salmon GA, Sykes AG (1993). Pulse Radiolysis and Related Studies on the Ru-Modified His-16 Derivative of *Anabaena variabilis* [2Fe-2S] Ferredoxin. *Biochim Biophys Acta* 1202:113-120.
- Pueyo JJ, Gomezmoreno C (1993). Interaction of Flavodoxin with Cyanobacterial Thylakoids. *Photosynth Res* 38:35-39.
- Redinbo MR, Cascio D, Choukair MK, Rice D, Merchant S, Yeates TO (1993). The 1.5-angstrom Crystal Structure of Plastocyanin from the Green Alga *Chlamydomonas reinhardtii*. *Biochemistry* 32:10560-10567.
- Schmitz S, Schrautemeier B, Bohme H (1993). Evidence from Directed Mutagenesis That Positively Charged Amino Acids Are Necessary for Interaction of Nitrogenase with the [2Fe-2S] Heterocyst Ferredoxin (FdxH) from the Cyanobacterium *Anabaena* sp., PCC7120. *Mol Gen Genet*

240:455-460.

Yakunin AF, Gogotov IN (1993). Natural Electron Donors for the Nitrogenase Reaction in the Cyanobacterium *Anabaena variabilis*. *Microbiology-Engl Tr* 62:53-57.

Yakunin AF, Hallenbeck PC, Troshina OY, Gogotov IN (1993). Purification and Properties of a Flavodoxin from the Heterocystous Cyanobacterium *Anabaena sphaerica*. *Biochim Biophys Acta* 1164:305-310.

Yakunin AF, Troshina OY, Gogotov IN (1993). Properties of Flavodoxin and Regulation of Its Synthesis in *Anabaena sphaerica*. *Microbiology-Engl Tr* 62:58-62.

Fresneau C, Riviere ME, Arrio B (1993). Characterization of the Plasmalemma ATPase from the Cyanobacteria *Synechococcus* PCC 6311 and PCC 7942. *Arch Biochem Biophys* 306:254-260.

Krenn BE, Vanwalraven HS, Scholts MJC, Kraayenhof R (1993). Modulation of the Proton-Translocation Stoichiometry of H<sup>+</sup>-ATP Synthases in Two Phototrophic Prokaryotes by External pH.[*Synechococcus*]. *Biochem J* 294:705-709.

Lill H, Burkovski A, Altendorf K, Junge W, Engelbrecht S (1993). Complementation of *Escherichia coli*-unc Mutant Strains by Chloroplast and Cyanobacterial F1-ATPase Subunits. *Biochim Biophys Acta* 1144:278-284.

Ohta Y, Yoshioka T, Mochimaru M, Hisabori T, Sakurai H (1993). Tentoxin Inhibits Both Photophosphorylation in Thylakoids and the ATPase Activity of Isolated Coupling Factor-F1 from the Cyanobacterium *Anacystis nidulans*. *Plant Cell Physiol* 34:523-529.

Margheri MC, Allotta G (1993). Homoacetic Fermentation in the Cyanobacterium *Nostoc* sp. Strain Cc from *Cycas circinalis*. *FEMS Microbiol Lett* 111:213-217.

Cobley JG, Zerweck E, Reyes R, Mody A, Seludounson JR, Jaeger H, Weerasuriya S, Navankasattusas S (1993). Construction of Shuttle Plasmids Which Can Be Efficiently Mobilized from *Escherichia coli* into the Chromatically Adapting Cyanobacterium, *Fremyella diplosiphon*. Plasmid 30:90-105.

Dolganov N, Grossman AR (1993). Insertional Inactivation of Genes to Isolate Mutants of *Synechococcus* Sp Strain PCC 7942 - Isolation of Filamentous Strains. J Bacteriol 175:7644-7651.

Marraccini P, Bulteau S, Cassier-Chauvat C, Mermetbouvier P, Chauvat F (1993). A Conjugative Plasmid Vector for Promoter Analysis in Several Cyanobacteria of the Genera *Synechococcus* and *Synechocystis*. Plant Mol Biol 23:905-909.

Mermet-Bouvier P, Cassier-Chauvat C, Marraccini P, Chauvat F (1993). Transfer and Replication of RSF1010-Derived Plasmids in Several Cyanobacteria of the General *Synechocystis* and *Synechococcus*. Curr Microbiol 27:323-327.

Soltesrak E, Kushner DJ, Williams DD, Coleman JR (1993). Effect of Promoter Modification on Mosquitocidal *cryIVB* Gene Expression in *Synechococcus* Sp Strain PCC 7942. Appl Environ Microbiol 59:2404-2410.

Chen XG, Widge WR (1993). Physical Genome Map of the Unicellular Cyanobacterium *Synechococcus* Sp Strain PCC 7002. J Bacteriol 175:5106-5116.

Elhai J (1993). Strong and Regulated Promoters in the Cyanobacterium *Anabaena* PCC 7120. FEMS Microbiol Lett 114:179-184.

Park HW, Sancar A, Deisenhofer J (1993). Crystallization and Preliminary Crystallographic Analysis of *Escherichia coli* DNA Photolyase.[*Anacystis*]. J Mol Biol 231:1122-1125.

Sakamoto T, Shirai M, Asayama M, Aida T, Sato A, Tanaka K, Takahashi H, Nakano M (1993). Characteristics of DNA and Multiple *rpoD* Homologs of *Microcystis* (*Synechocystis*) Strains. Int J Syst Bact 43:844-847.

Tominaga H, Hayashida Y, Hosoya Y, Kurokawa M, Sawa Y, Ochiai H (1993).

Characterization of a Small Cryptic Plasmid, pPF1, from *Phormidium foveolarum* and Vector Construction. *Biosci Biotechnol Biochem* 57:1795-1799.

Tominaga H, Soejima K, Kawagishi S, Ashida H, Sawa Y, Ochiai H (1993).

Structural Organization of a Cryptic Plasmid, pMA1, from *Microcystis aeruginosa* f. *aeruginosa* Kutzing. *Biosci Biotechnol Biochem* 57:1503-1507.

Yang XY, Mcfadden BA (1993). A Small Plasmid, pCA2.4, from the

Cyanobacterium *Synechocystis* Sp Strain PCC 6803 Encodes a Rep Protein and Replicates by a Rolling Circle Mechanism. *J Bacteriol* 175:3981-3991.

Filippovich II, Zabalueva KT, Zvereva MG, Shatilov VR (1993). Occurrence of

ribosome-containing structures in *Phormidium laminosum* photosynthetic membranes. *Photosynthetica* 29:409-416.

Kumar PA, Kruse E, Andriessse X, Weisbeek P, Kloppstech K (1993).

Integration of a Cyanobacterial Protein Involved in Nitrate Reduction (*narB*) into Isolated *Synechococcus* But Not into Pea Thylakoid Membranes. *Eur J Biochem* 214:533-537.

Zabalueva KT, Shatilov VR, Filippovich II (1993). Characterization of

ribosome-containing rod-like structures isolated from *Phormidium laminosum* photosynthetic membranes. *Photosynthetica* 29:463-467.

\*\*\*\*\* APPLIED CYANOBACTERIOLOGY \*\*\*\*\*

Megharaj M, Pearson HW, Venkateswarlu K (1993). Toxicity of Carbofuran to

Soil Isolates of *Chlorella vulgaris*, *Nostoc linckia* and *N. muscorum*. *Appl Microbiol Biotechnol* 39:644-648.

Prevot P, Perret E, Jupin H, Soyergobillard MO (1993). Fluorescence

Induction Used to Measure Parathion Toxicity in the Marine Dinoflagellate *Prorocentrum micans* - A Possible Model for Biodetection.[*Synechocystis*]. *Ecotoxicol Environ Safety* 25:360-371.

- Marquez FJ, Sasaki K, Kakizono T, Nishio N, Nagai S (1993). Growth Characteristics of *Spirulina platensis* in Mixotrophic and Heterotrophic Conditions. *J Ferment Bioeng* 76(5):408-410.
- Avery SV, Codd GA, Gadd GM (1993). Biosorption of Tributyltin and Other Organotin Compounds by Cyanobacteria and Microalgae. *Appl Microbiol Biotechnol* 39:812-817.
- Garnham GW, Codd GA, Gadd GM (1993). Accumulation of Zirconium by Microalgae and Cyanobacteria. *Appl Microbiol Biotechnol* 39:666-672.
- Gil JM, Serra JL (1993). Nitrate Removal by Immobilized Cells of *Phormidium uncinatum* in Batch Culture and a Continuous-Flow Photobioreactor. *Appl Microbiol Biotechnol* 39:782-787.
- Mahesh G, Kannaiyan S (1993). Effect of Immobilization of Cyanobacteria in Solid Matrix on Ammonia Excretion and Nitrogen Fixing Activity. *Biotechnol Lett* 15:975-978.
- Manoharan C, Subramanian G (1993). Feasibility studies on using cyanobacteria in ossein effluent treatment. *Indian J Environ Health* 35:88-96.
- Manoharan C, Subramanian G (1992). Sewage-cyanobacterial interaction -- a case study. *Indian J Environ Protection* 12:251-258.
- Manoharan C, Subramanian G (1993). Influence of effluents on fatty acid content of a cyanobacterium. *Curr Sci* 65:353-354.
- Porter AG, Davidson EW, Liu JW (1993). Mosquitocidal Toxins of Bacilli and Their Genetic Manipulation for Effective Biological Control of Mosquitoes. *Microbiol Rev* 57:838-861.
- Reyes JC, Chavez S, Muropastor MI, Candau P, Florencio FJ (1993). Effect of Glucose Utilization on Nitrite Excretion by the Unicellular Cyanobacterium *Synechocystis* Sp Strain PCC 6803. *Appl Environ Microbiol* 59:3161-3163.
- Subramanian G, Rajini VS, Uma L (1992). Studies on cyanobacterial immobilization. In: *Biological Nitrogen Fixation and Biogas Technology*,

Kannaiyan S, et al, eds. Tamilnadu Agricultural Univ, India. pp.7-11.

Uma L, Subramanian G (1990). Effective use of cyanobacteria in effluent treatment. National Symposium on Cyanobacterial Nitrogen Fixation. I.A.R.I, New Delhi. pp.438-444.

=====

ADDRESSES\*ADDRESSES\*ADDRESSES\*ADDRESSES\*ADDRESSES\*ADDRESSES\*ADDRESSES\*ADDRE

=====

Send CONTRIBUTIONS to one of the addresses listed below. To SUBSCRIBE, send \$10 U.S. (or equivalent in any currency) per year to Jeff Elhai, along with your name, telephone, fax, and E-mail numbers (if any), and a brief description of your research interests for inclusion in the next Directory of Cyanobacteriologists. If it is difficult for you to send hard currency, send a note indicating your interest. There is no charge to receive the newsletter by E-mail. If you ask to receive the newsletter electronically, please specify whether you want it in ASCII format (printable by any printer, but with no fonts and little formatting) or a format ready to be printed on printer, preferably a Hewlett-Packard LaserJet III-compatible printer, but others are also possible.

AUSTRALIA	Steve Delaney	Department of Biotechnology, University of New South Wales, P.O. Box 1, Kensington, New South Wales AUSTRALIA 2033
/NEW ZEALAND		
AUSTRIA	Georg Schmetterer	Institut fur Physikalische Chemie, Wahringerstrasse 42, A-1090 Wien (EMail) A8422dad@Awiuni11
CANADA	Neil Strauss	Dept. of Botany, University of Toronto, Toronto, Ontario M5S 1A1. (E-mail) StrausNA@gpu.utcs.UToronto.Ca

P.R.CHINA	Chao-Tsi Tseng	Centre of Marine Sciences, Department of Biology, Nanjing University, Nanjing
CZECHOSLOV.	Jiri Komarek	Institute of Botany, CAS Dept. of Hydrobotany, Dukelske 145, CS-37982 Trebou
FRANCE	Nicole Tandeau de Marsac	Physiologie Microbienne, Institut Pasteur, 29 rue du Dr. Roux, 75724 Paris Cedex 15.  (EMail) NTMarsac@Pasteur.Fr
GERMANY	Wolfgang Lockau	Biochemie der Pflanzen, Fachbereich Biologie, Humboldt-Universitaet, Invalidenstr. 42, 10 115 Berlin
INDIA	Joe Thomas	Biotechnology Division, SPIC Science Foundation, 110 Mount Road, Madras 600 032
ISRAEL	Elisha Tel-Or	Dept. of Agricultural Botany, The Hebrew University, Rehovot 76100  (Tel) 08-481262
ITALY	Mario Tredici	Centro di Studio dei Microorganismi Autotrof. (C.N.R.), P.le. delle Cascine 27 51044 Firenze  (E-mail) D47000@Ifiidg.Fi.Cnr.It
NETHERLANDS	Luuc Mur	Laboratorium voor Microbiologie, Universiteit voor Amsterdam, Nieuwe Achtergracht 127, 1018 WS Amsterdam
SCANDANAVIA	Olav Skulberg	Norwegian Institute for Water Research, P.O.box 69 Korsvall, N-0808 Oslo 8 NORWAY
U.K.	Tony Walsby	Dept. of Botany, University of

ANYWHERE ELSE Jeff Elhai

Bristol, Bristol BS8 1UG

Dept. of Biological Sciences, Florida

International University, University

Park Campus, Miami FL 33199 USA.

(Tel) 305-348-3584, (Fax) 305-348-1986

(E-mail) [Cyano@Servax.Bitnet](mailto:Cyano@Servax.Bitnet)

or [Cyano@Servax.Fiu.Edu](mailto:Cyano@Servax.Fiu.Edu)