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CYANONEWS is 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. If you have a new result, if you know of an interesting meeting, if you have a post-doctoral opening, if you want strains, if you've published/submitted an article, if you have an insight or speculation into the cyanobacterial world... why not tell us about it? It's news to us. Your ADDRESS LABEL shows the date of your last communication. If that was more than two years ago, please send some message, if only to tell us that the address is still correct and you're still interested (but since you're writing anyway, a little news couldn't hurt).

Please send all contributions to one of the addresses listed on the last page. DEADLINE for the next issue is JUNE 1, 1988.

The name of the CORRESPONDENT for each item in this newsletter is capitalized, so you know who to write to for more information. The CORRESPONDENT'S ADDRESS appears at the end of the newsletter.

The annual meeting of the Phytochemical Society of North America will feature a SYMPOSIUM ON RECENT DEVELOPMENTS IN PRIMARY AND SECONDARY NITROGEN PHYTOCHEMISTRY. The meeting will be held at the University of Iowa, June 26-30, 1988. It is not restricted to PSNA members. Funds are available allowing travel assistance for graduate students giving oral presentations. For more information, contact J.E. Poulton, Dept. of Botany, The University of Iowa, Iowa City, Iowa 52242, U.S.A. (tel.) 319-335-1322.

Plön, West Germany, will be the site of the Xth INTERNATIONAL SYMPOSIUM ON CYANOBACHT RESEARCH, to be held July 30 - August 10, 1989. The program will be organized with alternating blocks of formal presentations and microscope work. Inquiries should be directed to: Barbara Hickel, Max-Planck-Institute for Limnology, Department of Microbial Ecology, August-Thiemenmann-Straße 2, D-2320 Plön, F.R. Germany. (Tel) (0049) 4522 802 (1) 252.

There will be a TRAINING COURSE IN MASS CULTURES OF MICROALGAE held July 17-29, 1988, at the Jacob Blaustein Institute for Desert Research. The aim of the course is to have students acquire tools for monitoring, analyzing, and solving practical problems prevalent in large-scale cultivation of microalgae. Lectures will be accompanied by practical work, both in the laboratory and outdoors. The fee of U.S. $900 includes room and board on campus and a two day tour of the southern part of Israel. A B.Sc. in biological science (or an equivalent university degree) is prerequisite. Applications should include a C.V., and a letter of recommendation should be sent on behalf of the applicant. For more information and registration, contact: Avigad Vonshak, The Laboratory for Microalgal Biotechnology, The Jacob Blaustein Institute for Desert Research, Ben-Gurion University at Sede-Boker, 84993, Israel.

PETER WOLK is organizing a 10-day BACKPACKING TRIP to the Muir Wilderness of California for this summer (June 28 - July 11, or September 6 - 17, 1988. Other dates are possible). If you are interested in participating, contact him at 517-353-2049, or write promptly, as the wilderness supervisor fills requests for permits for specific dates on a first-come, first-served basis starting early in March. The trip offers splendid scenery, good exercise, and a fine chance to become better acquainted with other cyanobacteriologists.
MONOGRAPH APPEARS ON PHILIPPINE NITROGEN-FIXING BLUE-GREEN ALGAE

A special issue of The Philippine Agriculturist has appeared (Vol. 69, no. 4B, 1986), entitled "Studies on Nitrogen-Fixing Blue-Green Algae and Their Symbiotic Forms in the Philippines", M.R. Martinez, P.A. Roger, and B.L. Mercado, eds. Most of the twelve papers included in the issue are devoted to the biochemical characterization and ecology of cyanobacteria of the Philippines, aimed at understanding their role in regional nitrogen fixation and their exploitation in agriculture beyond wetland rice. The issue is 120 pages and sells soft bound for U.S. $10 (includes handling and surface mailing). Contact the CA Publications Office, Basement, International House Bldg., UP at Los Banos, College, Laguna. Tel. 2379.

NOMENCLATURE RULES FOR CYANOBACTERIAL GENES PROPOSED

JEAN HOUMARD and NICOLE TANDEAU DE MARSA have finished updating a compilation of cloned cyanobacterial genes (which will appear in Methods in Enzymol., A.N. Glazer and L. Packer, eds., 1988). Having surveyed the current state of affairs, they think it is time to try to standardize the nomenclature of cyanobacterial genes. With this in mind they have proposed the following rules:

(1) Gene designations proposed for Escherichia coli and/or Bacillus subtilis must be used whenever possible.

(2) For functions specifically related to photosynthesis, gene designations employed for photosynthetic bacteria or plants can be used.

(3) Designations already in use for bacterial genes must be avoided if the cyanobacterial gene products have not been identified or are functionally different from those previously published.

(4) Genes that are involved in the formation of multimolecular complexes (structure, assembly, and/or regulation) or that are part of a given metabolic pathway can be designated by different capital letters appended to a unique three lower-case letter root. The following are given as examples:
  - apcA to apcZ - genes related to allophycocyanin
  - atpA to atpZ - genes related to the ATPase complex
  - cpcA to cpcZ - genes related to phycocyanin
  - cpeA to cpeZ - genes related to phycocerythrin
  - metA to metZ - genes related to the methionine biosynthetic pathway
  - nifA to nifZ - genes involved in nitrogen fixation
  - psaA to psaZ - genes related to photosystem I
  - psbA to psbZ - genes related to photosystem II

(5) Arabic numerals following a gene designation are used to identify the various copies within a multi-gene family (e.g., psbA1, psbA2, psbA3, ...).

(6) The allele numbers of a given locus must be identified by arabic numerals preceded by a hyphen (e.g. atpA-1, cpcB2-1, psbD1-3, ...).

LIST OF CYANOBACTERIAL REFERENCES FOR 1986 AVAILABLE

If your appetite for cyanobacterial references is unsated, then you’ll be happy to hear that JEFF ELHAI has made available a (nearly) exhaustive list of 1986 references concerning cyanobacteria in journals covered by Science Citation Index. There are about 440 of them, residing on a floppy diskette. If you would like a copy, and have access to a personal computer that can read 5-1/4 inch disks formatted by either CP/M or MS-DOS, please send him a note specifying which format you would prefer (you can if you like include a disk along with the request). If you don’t have access to a computer that can read such a disk, a printed copy is available (55 pages), but only as a last resort. The list is only (nearly) exhaustive, because some titles that don’t have the word "cyanobacteria", "blue-green algae", or derivatives, or a generic name would have been missed by the computer search. After laboring a few hours over the keyboard, J.E. would like to make the suggestion that authors sacrifice a small measure of their poetic freedom to the computer and struggle to find a place for "cyanobacterium" in their titles.
SUBUNIT STRUCTURE OF CYANOBACTERIAL RNA POLYMERASES DISTINGUISHES BLUE-GREENS FROM EUBACTERIA

BOB HASELKORN sent us some hot stuff from the thesis of George Schneider, part of which recently appeared (Schneider, et al., J.Biol.Chem.). Anabaena RNA polymerase contains five kinds of subunits:

- $\alpha$ - related to E.coli $\alpha$
- $\beta$ - strongly related to E.coli $\beta$, contains the nucleotide binding site.
- $\beta'$ - weakly related to E.coli $\beta'$
- $\gamma$ - 66 kDa protein related to E.coli $\beta'$ (1)
- $\sigma$ - 52 kDa, related to E.coli $\sigma$^70

Stoichiometry: $\beta'\beta{x}_{2}\gamma_{2}$ for holoenzyme, $\beta'\beta{x}_{2}$ for core.

All cyanobacteria tested to date (15 species) have the subunit. This distinguishes them from all other eubacteria and places them, as a group, closer to archaeabacteria.

PHOTOSYSTEM II DONOR D (AND Z?) IDENTIFIED

WIM VERMAAS tells us a tale of a recent discovery. For years, Z, the donor to the Photosystem II (PSII) reaction center, and D, an oxidizable PSII component structurally resembling Z, were assumed to be plastoquinones. This assumption rested essentially on a variety of EPR and ENDOR measurements made on the oxidized donors. However, the observed stoichiometry of extractable plastoquinone and other PSII components could not account for Z and D.

So what, in fact, is Z and D? Independently, Gerry Babcock, Bridgette Barry, Rick Debus, and Lee McIntosh at Michigan State University and Vermaas' group at Arizona State University considered the possibility that Z and D instead of quinols were tyrosyl residues in D1 (encoded by psbA) and D2 (psbD). Tyrosine radicals might be expected to yield similar signals as those seen in PSII by EPR and ENDOR. Recently, Barry and Babcock showed by selective deuteration experiments that, indeed, D and Z probably were tyrosine residues.

But which tyrosine? Both groups guessed Tyr-161 residues in D1 and D2 (using residue numbering as in spinach). The rationale was that the two tyrosine residues are: (a) conserved in all species for which a D1 or D2 sequence is available, and (b) expected to be virtually adjacent to the histidine residues associated with P680-binding. Therefore, simultaneously and independently at both ASU and MSU, this tyrosine residue in D2 was targeted for site-directed mutagenesis (changing it into phenylalanine), using the Synechocystis 6803 system. The site-directed mutant was found to have lost EPR Signal IIIs (and thus D^*), and to have reduced photoautotrophic growth. Vermaas' group also altered the adjacent methionine residue to an argenine. This did not lead to the disappearance of the EPR signal, thus, the loss of Signal IIIs was specifically correlated to alteration of the Synechocystis Tyr-160 residue (homologous to spinach Tyr-161) in D2. This argued persuasively that this tyrosine residue in D2 indeed is D, and by analogy, that the homologous tyrosine residue in D1 is Z.

One lesson from this tale is that site-directed mutagenesis in Synechocystis 6803 is a powerful and relatively simple tool for the analysis of structure and function of PSII components. However, Wim pointed out another lesson: the unintentional duplication of effort by the MSU and ASU groups is proof of how important it is to have a frequent information exchange between the various groups working on directed mutagenesis. This exchange should not only cover what has been done, but also what will be done. Perhaps Cyanonews would be a suitable forum for this? [See Publication section for reference to work by Debus, et al.]

MEETING REPORTS ON RESPONSES OF CYANOBACTERIA TO STRESS

[The following are two reports left over from last newsletter's summary of two meetings: Molecular Biology of Photosynthetic Prokaryotes (June 8-10, 1987) and Second Workshop on the Molecular Biology of Cyanobacteria (July 17-19, 1987)]

David Laudenbach reported on the regulation of ferredoxin and flavodoxin genes. The genes encoding these proteins have been cloned from Anacystis nidulans R2, and Southern hybridization analysis indicates that each gene exists in single copy. The gene encoding ferredoxin is transcribed constitutively whereas the flavodoxin mRNA appears only in a medium low in iron and disappears upon the readdition of iron. The ferredoxin gene is transcribed as a monocistronic message. The flavodoxin gene, however, is transcribed on a polycistronic message. Two unidentified open reading frames are also on this message.
Work presented by Malcolm Potts concerns the response of Nostoc commune to dessication. He is interested in the effects of water stress on gene expression in both laboratory and field samples. Two genes in particular were investigated: the gene encoding the large subunit of RNA polymerase and the gene encoding alkaline phosphatase. The latter was cloned and expressed in E. coli under control of its own promoter.

- contributed by FLORENCE GLEASON and TOIVO KALLAS

The summary of the Cyanobacterial Workshop in the last newsletter reported that one of Valdis Dzelzkalns' dextrose-requiring mutants owed its phenotype to a deletion in psbD. Actually, at the time of the Workshop, he had narrowed the deletion to a fragment that spans psbD and psbC. Since the time of the meeting, he has finished sequencing both the wild type and mutant copies of this region and has found that the deletion is in psbC.

The recent Directory of Cyanobacteriologists had several misprints, but one major blunder warrants correction. Andriana Pantazidou was listed as Pantazidou Andriana and therefore was misplaced among the A's. Secondly, A.P., who has never heard of Eudolithic cyanobacteria, works instead on the endolithic variety.


Send CONTRIBUTIONS to one of the addresses listed below. If you wish to be included in the mailing list, send your name, address, telephone number, and a brief description of your research interests.

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DIRECTORY OF CYANOBACTERIOLOGISTS

September 1987

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Toxicity of cyanobacteria

Protein phosphorylation and excitation energy distribution

Physiology, biochemistry
Cell inclusions
Unicellular cyanobacteria

Nitrogenase, Hydrogenase
Photosynthesis, Biosolar energy conversion,
Storage compounds, Trace elements

Phycobilisome structure, assembly, expression

Ribulose bisphosphate carboxylase/oxygenase
Inorganic carbon uptake
Carboxysomes
Biochemical genetics

Eudolithic cyanobacteria
Taxonomy
Biochemistry

Nitrogen fixation -- physiology, genetics, biochemistry
Ion transport
Salt tolerance

Spirulina
Mass algal culture
S	Balkwill, David L.  Dept. of Biological Science  
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	Structure and function  
	Localization of intracellular enzymes with immunocytochemical probes

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	Nitrogen fixation  
	DNA transfer  
	Fatty acid biosynthesis

S	Beale, Sam  Brown University  
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	Pigment biosynthesis

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	Electron transport and photophosphorylation

S	Benemann, John R.  School of Applied Biology  
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	Nitrogenase  
	Mass culture  
	Specialty products

S	Bergman, Birgitta  Inst. of Physiological Botany  
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	Structure and function of free-living and symbiotic nitrogen-fixing cyanobacteria

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	Respiration/photosynthesis  
	Nitrogen Fixation  
	Light-induced hydrogen evolution

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Mineral nutrition (B, Mo)  
Dinitrogen fixation

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Molecular biology  
Heat shock and heavy metal stresses

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Toxins  
Plasmid function

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Metabolism and genetics

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Ammonia translocation

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Photosynthesis  
Mechanisms in Photosystem I

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Trace metal uptake  
Toxins

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Regulation of photosynthetic  
electron transport by  
internal ion distribution

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Toxicology  
Pharmacology  
Immunology

Heterocyst differentiation  
Nitrogen fixation

Structure of PSI and PSII  
Genetics

Photosynthesis  
Carbohydrate dynamics

Nitrogen metabolism  
Bioenergetics

Cyanophages  
Pesticide effect on cyanophages and cyanobacteria

Cyanobacterial toxins: isolation, characterization regulation

Gene-transfer into and out of cyanobacteria

Genomic rearrangement
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Ecology/physiology
Ecology of hot springs
Sulfide effect on cyanobacteria

Nitrogen Fixation
Cloning of photosynthetic genes from unicellular cyanobacteria
Plasmid function

Nitrogen fixation
Hydrogen metabolism

Nitrogen fixation by terrestrial cyanobacteria
Uptake of cyanobacteria by plant protoplasts

Genetics and genetic engineering

Biochemistry and molecular biology of Spirulina

Mechanism of chromatic adaptation
Fremyella diphosphon

Physiology and biochemistry of carbon dioxide assimilation
Carboxysomes
Toxins

Regulation of gene expression
Inorganic carbon transport
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution/Department</th>
<th>Research Interests</th>
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<tbody>
<tr>
<td>Conley, Pamela B.</td>
<td>Dept. of Plant Biology, Carnegie Inst. of Washington</td>
<td>Phycobilisome poly-peptide genes from chromatically-adapting cyanobacteria,</td>
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<td>Carbon uptake and metabolism</td>
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<td>Cook, Catherine M.</td>
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<td>Cramer, William A.</td>
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<td>Curtis, Stephanie</td>
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<td>Heterocyst differentiation</td>
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<td>Day, J.G.</td>
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<td>Physiological, biotechnological, and aspects of micro-algae</td>
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<td>Duerr, Eirik O.</td>
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<td>(Tel) 808-259-7951</td>
<td>Nitrogen fixation</td>
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<td>Culture physiology</td>
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</tbody>
</table>
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Regulation of gene expression

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Physiology and genetics of nitrogen fixation

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Genetics of heterocyst differentiation

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Photosynthesis
Heavy metal tolerance
Molecular biology
Algal physiology

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Photosynthesis
PSII reaction center
Thylakoid membrane biogenesis
Light regulation

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Toxins - mechanisms of action and structures

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Nitrogenase, hydrogenase
Photosynthesis, biosolar energy conversion
Storage compounds
Trace elements

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Cyanobacterial toxicity

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Heterocyst and akinete development
Acclimation to natural light climate

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Plasmid biology
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Mineral nutrition  
Nitrogen metabolism  
Dinitrogen fixation

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Models for growth, metabolism, Red Oscillatoria

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Ecology  
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Physiological ecology of planktonic cyanobacteria

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Gene expression  
Plasmids, vectors  
Genes of the photosynthetic apparatus

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Fatty acid biosynthesis

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Nitrogen fixation  
Non-heterocystous cyanobacteria

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Ion transport  
Membrane function  
Nitrogen-metabolism

Photosynthesis  
Molecular biology

Thioredoxin & glutaredoxin: role in cyanobacterial metabolism  
Secondary metabolites: isolation and characterization

Molecular biology of heterocyst differentiation and nitrogen fixation

Physiology  
Molecular Biology

Sulfur starvation of Anacystis R2

Symbiotic association with cycads  
Nitrogen fixation by unicellular cyanobacteria

Ultrastructure  
Biology of cyanobacteria and cyanophages

Phycobilisome biosynthesis  
Regulation of phycobilisome genes  
Adaptation of cyanobacteria to stress
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<tr>
<th>Name</th>
<th>Institution</th>
<th>Research Areas</th>
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<tr>
<td>Hallbom, Lars</td>
<td>Inst. of Physiological Botany University of Uppsala</td>
<td>Toxin production (especially Oscillatoria, Lyngbya, an Nodularia)</td>
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<td>Box 540 S-751 21 Uppsala SWEDEN (Tel) 46 - 18 - 18 28 14</td>
<td>Large scale production techniques</td>
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<td>Hansburg, Wilhelm</td>
<td>Centro Invest. Fijacion de Nitrogeno UNAM Chamilpa</td>
<td>Glutamine synthetase</td>
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<td>Ap. Postal 565-A Cuernavaca, Mor. MEXICO (Tel) 73-13 99 08 or 13 71 95</td>
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<td>Hayes, Paul</td>
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<td>Gas vacuole proteins</td>
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<td>Hernandez-Muñiz, Wilfredo</td>
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<td>Motility</td>
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<td>Hoffmann, L.</td>
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<td>Taxonomy and ecology</td>
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<td>B-4000 LIEGE BELGIUM (Tel) 41-565418</td>
<td>Calcification in terrestrial habitats</td>
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<td>Carnegie Institution Department of Plant Biology 290 Panama St.</td>
<td>Adaptation to sulfur starvation in blue-greens and Chlamydomonas</td>
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<td>Stanford, CA 94305 U.S.A. (Tel) 415-325-1521</td>
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<td>Houghton, James</td>
<td>Dept. of Microbiology University College Galway IRELAND</td>
<td>Genetics and genetic engineering</td>
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<td>Huang, Tan-Chi</td>
<td>Institute of Botony Academia Sinica Nankang, Taipei Taiwan Taiwan R.O.CHINA</td>
<td>Physiology Taxonomy</td>
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<td>BLR RSMA University of Miami 4600 Rickenbacker Causeway Miami, FL 33149 U.S.A. (Tel) 305-361-4626</td>
<td>Nitrogen fixation and carbohydrate metabolism Interaction of photosynthesis and N-fixation</td>
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<td>Dept. of Chemistry Faculty of Science Kyoto University</td>
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<td>Kyoto 506 JAPAN (Tel) 075-751-2111 ext. 3996</td>
<td>Phosphoenolpyruvate carboxylase gene structure and regulation</td>
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<td>Jäger, Karin</td>
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<td>Blacksburg, VA 24061 U.S.A. (Tel) 703-961-5745</td>
<td>Terrestrial cyanobacteria Recombinant DNA Gene expression in vitro translation Dessicat'n-wetting tolerance</td>
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<td>Jaworski, Jan</td>
<td>Miami University Chemistry Department Oxford, OH 45056 U.S.A. (Tel) 513-529-2094</td>
<td>Fatty acid biosynthesis</td>
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<td>Jensen, Thomas E.</td>
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<td>Morphology Cell inclusions Response to heavy metals</td>
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<td>Joset, Francoise</td>
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<td>Physiology and genetics</td>
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<tr>
<td>Kaas, Hanne</td>
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<td>Salt marsh cyanobacteria Taxonomy and ecology</td>
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<tr>
<td>Kallas, Toivo</td>
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<tr>
<td>Kalosaka, Katerina</td>
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<td>Photosynthesis</td>
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<td>Kaplan, Aaron</td>
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<td>Photosynthesis Ion transport CO2 concentrating system</td>
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</table>
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Cloning and expression of cyanobacterial genes

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Enhancement of photosynthetic CO2 fixation  
Phosphoenolpyruvate carboxylase

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Algal physiology, biochem.  
Restoration of desert algal crusts in Africa

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Planctic blue-green algae  
Nitrogen metabolism  
Toxins  
Bloom-formation  
Resource use

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Cytology, fine structure  
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Photosynthesis  
Structure of protein catalysts  
Evolution

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Buoyancy regulation  
Gas vesicle synthesis  
Carbon metabolism

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Physiological ecology  
Nitrogen fixation  
Pleomorphy  
Endo-epilithic, hypersaline microorganisms

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Hydrogen metabolism  
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Carboxysomes
Carbon metabolism

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Control of gene expression
Molecular biology of heavy metal resistance

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Plasmid replication and function

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Recombinants in filamentous cyanobacteria

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Photosynthesis
Nitrogen fixation
Genetics

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Nitrogen fixation

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Symbiosis
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Chloroplast, cyanelle, and cyanobacterial genomes

Photosynthesis  
Lipid and fatty acid metabolism  
Molecular genetics

Genetics and molecular biology

Nitrogen metabolism

Autotrophy  
Catalysis by RBCase/oxygenase  
Transformation

Physiology  
Symbiosis  
Regulation of metabolism and cell differentiation

Expression of photosynthesis genes in A. nidulans and Chlamydomonas

Cyanobacterial products  
Biofertilizers/N2-fixation  
Microbial ecology of soil cyanobacteria

Structure and function of reaction centers and high harvesting complexes

Transport processes for bicarbonate and CO2  
Sodium in transport and pH regulation  
pH regulation
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Hydrogen metabolisms
Nitrogen fixation
Marine cyanobacteria
Utilization for food, feed, chemicals, medicine, fuel

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Thioredoxin
Carbon metabolism - regulation

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Nitrogen fixation
Gene rearrangements
Heterocyst differentiation
Transcription

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Membranes and lipids

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Nitrogen fixation - physiology, molecular biology
Heterocyst development

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Volatile compounds, factors influencing production, biosynthetic pathways

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Metal & organic pollution
Taxonomy
Cyanophages
Ecophysiology
Nitrogen fixation

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Molecular gentics of bacterial plant pathogenesis

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Physiology (regulation by growth environments)  
Biochemistry of phycobiliproteins  
Molecular biology of cyanobacteria  
Regulation of gene expression (SOS repair)  
Carbon metabolism  
Carbon uptake  
Bioenergetics  
Bioenergetics  
Molecular genetics  
Photosynthesis  
Physiological ecology  
Nitrogen fixation  
Cyanobacterial-bacterial interactions, symbioses  
Photosynthesis  
Membrane organization  
Genetics of unicellular cyanobacteria  
Photosynthesis  
Production of bioactive secondary metabolites by algae  
Physiology of microalgae/ cyanobacteria  
Applied microbial ecology
<table>
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<tr>
<th>Name</th>
<th>Institution</th>
<th>Address</th>
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<tr>
<td>Pentecost, Allan</td>
<td>King's College London</td>
<td>London U.K.</td>
<td>Ecophysiology</td>
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<td>Peters, Gerald A.</td>
<td>Battelle-Kettering Res. Lab.</td>
<td>150 E. South College St. Yellow Springs, Ohio 45382 U.S.A.</td>
<td>Azolla-cyano symbiosis Nitrogen fixation by free-living and symbiotic cyanobacteria (Tel) 513-767-7271</td>
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<td>Pettersson, Annette</td>
<td>Inst. of Physiological Botany</td>
<td>University of Uppsala Box 540 S-751 21 Uppsala Sweden</td>
<td>Metal toxicity Ion transport Physiology Ultrastructure</td>
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<td>Philbrick, Judy</td>
<td>Cook College, Rutgers Univ. Cept. of Biochem. &amp; Microbiol. Lipman Hall New Brunswick, NJ 08903 U.S.A. (Tel) 201-932-9563</td>
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<td>Oxygen evolution Photosynthesis genes</td>
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<td>Post, Anton</td>
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<td>University of Amsterdam Nieuwe Achtergracht 127 1018 WS Amsterdam NETHERLANDS (Tel) 31-20-522-4070</td>
<td>Ecophysiology and photosynthesis</td>
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<td>Potts, Malcolm</td>
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<td>Virginia Polytechnic Inst. Blacksburg, VA 24601 U.S.A. (Tel) 703-961-6315</td>
<td>Gene expression in cyanobacteria undergoing water stress and dessication</td>
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<td>Priestly, Ian M.</td>
<td>Department of Biological Sci.</td>
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<td>Ecological and public health implications of toxic cyanobacteria Tissue culture techniques</td>
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<td>Rai, Amar N.</td>
<td>Department of Biochemistry</td>
<td>School of Life Sciences North-Eastern Hill University Shillong 793 014 INDIA (Tel) 25136</td>
<td>Nitrogen metabolism in free-living and symbiotic cyanobacteria</td>
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<td>Ramage, Bob</td>
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<td>Rubisco</td>
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<td>Life Sciences</td>
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<td>Molecular genetics of photosynthesis</td>
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Glycolate metabolism
Nitrogen metabolism
Ecology of nitrogen-fixing
cyanobacteria
Azolla/Anabaena symbiosis
Growth physiology
Mass cultures for products
of economic potential
Photosynthesis
Regulation of photosynthesis
gene expression
Photosynth./respiration
Oxidative phosphorylation
Cytochrome oxidase
NAD(P)H-dehydrogenase
Systematics
Continuous culture
Adaptation
Ammonia metabolism
Experimental field ecology
Respiration
Genetics
Sulfur metabolism
Purification of enzymes,
e.g. phycobiliproteins,
restriction enzymes.
Interaction of photosynthesis and nitrogen fixation
Carbon metabolism

Photosynthetic electron transport
Metabolism of nonprotein

Photosynthesis
Membrane structure
Genetics and molecular biology
Unicellular cyanobacteria

Azolla-Anabaena symbiosis
Energy metabolism in immobilization of cyanobacteria

Gene organization of photosynthetic apparatus
Transformation
Endosymbiosis

Rubisco
Carbon dioxide fixation, regulation
Carboxysomes

Amino acid sequences of biliproteins and linker polypeptides
Red algae and cryptomonads

Genetics
Development
Cell inclusions

Nitrogen fixation
Molecular genetics
Ammonium transport
Herbicide resistance
Hydrogen production

Nitrogen fixation
Physiology
Ecology and biofertilization to rice crop
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<td>Skulberg, Olav M.</td>
<td>Norwegian Institute for Water Research, Oslo 3 NORWAY</td>
<td>Taxonomy, Toxins, Allelopathy, Antarctic bluegreens</td>
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<tr>
<td>Smith, Arnold J.</td>
<td>Department of Biochemistry, Aberystwyth, Dyfed, Wales U.K.</td>
<td>Uptake and assimilation of exogenous substrates, Synthesis of tetrapyrroles</td>
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<td>Smith, Geoffrey D.</td>
<td>Dept. of Biochemistry, Australian Nat'l University, Canberra, A.C.T.</td>
<td>Hydrogen and nitrogen metabolism</td>
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<td>Smith, R.J.</td>
<td>Dept. of Biological Sciences, Lancaster, Bailrigg, Lancaster LAI 3JC U.K.</td>
<td>Heterocyst regulation, Cyanophage mol. genetics, Calcium-mediated regulation</td>
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<td>Sotiropoulou, Georgia</td>
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<td>Photosynthesis</td>
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<td>Stevens, Edward S.</td>
<td>101 S. Frear, Pennsylvania State University, University Park, PA U.S.A.</td>
<td>Metabolic regulation in prokaryotes, Nitrogen metabolism, Pigment biosynthesis,</td>
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<td>Straus, Neil A.</td>
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<td>Regulation of gene expression for electron transport proteins, Replication origins in</td>
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<td>Anacystis nidulans R2</td>
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<td>Sugiura, Masahiro</td>
<td>Center for Gene Research, Nagoya University, Nagoya 464 JAPAN</td>
<td>Structure and expression rRNA, tRNA and ribosomal protein genes</td>
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<td>Sutton, Ann</td>
<td>Dept. Biology, Brookhaven National Laboratory, Upton, NY U.S.A.</td>
<td>Regulation of genes of photosystem II in vegetative cells and heterocysts of Anabaena</td>
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Homologous recombination  
Heterologous gene expression  
Site-directed alteration of polypeptides

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Nitrogen fixation and metabolism  
Carbon dioxide fixation

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Plasmids and restriction endonucleases

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Mass culture of Spirulina and nitrogen-fixers  
Biotechnology  
Extraction of pigments from algae
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<th>Name</th>
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<tr>
<td>Thuriaux, Pierre</td>
<td>Service de Biochimie Bat 142 C.E.N. Saclay C.E.N. Saclay 91191 Gif Sur Yvette Cedex FRANCE (Tel) 908-35-86</td>
<td>Cloning of photosynthetic genes from unicellular cyanobacteria Plasmid function</td>
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<td>Tiboni, Orsola</td>
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<td>Control of cell division by magnesium Extracellular products control of synthesis</td>
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<td>Van der Oost, John</td>
<td>Plantenfysiologie de Boelelaan 1087 1081 HV Amsterdam NETHERLANDS (Tel) 020-5485704</td>
<td>Hydrogen metabolism Non-heterocystous cyanobacteria</td>
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<td>Expression of photosynthesis genes in Anacystis R2</td>
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<td>Transformation Photosystem II</td>
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Regulation of photosynthetic gene expression
Stress responses
Cell wall and envelope
Sheath of cyanobacteria
Toxins from cyanobacteria
Genetics
Photosynthesis
Transport
Regulation
Nitrogen fixation, rice
Heavy metal accumulation
Biology of Rivulariaceae
Fatty acid biosynthesis
genes
Electron transfer
b-cytochrome function
Cyanophytes in fresh and brackish waters
Toxin-producing cyanophytes
PSII modification
Genetics
Cultivation
Taxonomy
Stabilization of sandy surfaces
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Gene expression  
Physiology  

Development, physiology, and genetics  

Photosynthesis  
Marine Synechococcus spp.  

Cyanophages  
Transformation and transduction  
Proteolysis  
Amino acid utilization  

Microbial lysis of cyanobacteria  
Pesticide effects  

Marine cyanobacteria  
Phycobiliproteins  
Photosynthesis  

Photosynthesis, pigments  
Ecophysiology, nutrient uptake  
Competition, succession  

Photosynthetic electron transport (PSII)  
Phycobilisome structure, function and assembly  

Nitrogen fixation and excretion  
Heterocystous cyanobacteria  
Azolla-Anabaena symbiosis  
Symbiotic cyanobacteria
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<td>I.R. Falconer (Ammidale)</td>
<td>Shree Kumar Apte (Bombay)</td>
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<td>P.R.CHINA</td>
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<td>Nansen Olsen (Oslo)</td>
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<td>George Borbély (Szeged)</td>
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Toyo Kallas (Berkeley, Calif.)
Jeff Gingrich (Berkeley, Calif.)
Lester Packer (Berkeley, Calif.)
Jim Hallis (Davis, Calif.)
Jack Meeks (Davis, Calif.)
Richard Castenholz (U.Oregon)
Eugene Sterner (U.Washington)
Bruce McFadden (Washington St.U.)
William J. Zimmerman (Washington St.U.)
P.A.S. Reynaud (RSA Plant-Soil, Wash.)
Blaine Malting (RSA Plant-Soil, Wash.)
Elrik O. Duerr (Ocean Inst., Hawaii)
Gregory Patterson (U.Hawaii)
Clark Lee (U.Hawaii)

U.S.A. (East)

Valdis Dzelzkalns (Harvard U.)
Sabeena Merchant (Harvard U.)
Mary Mennes Allen (Wellesley Coll.)
Yael J. Avissar (Brown U.)
Sam Beale (Brown U.)
Judy Philbrick (Rutgers U.)
Barbara Zitlinskas (Rutgers U.)
Thomas E. Jensen (New York City, NY)
Ann Sutton (Brookhaven, NY)
Joan Gebhardt (Rensselaer Polytech.)
Greg Boyer (Syracuse, NY)
Robert D. Simon (Geneseo, NY)
Jane Gibson (Cornell U.)
Atadar A. Szalay (Cornell U.)
W.E. Dietrich Jr. (Indiana U., Penn.)
Edward S. Stevens (Penn.St.U.)
Wilfredo Hernandez-Huiz (Penn.St.U.)
John Williams (DuPont, Delaware)
Sheldon E. Broedel Jr. (Baltimore, Maryland)
Rick Wolf (Baltimore, Maryland)
Karin Jäger (Virginia Polytech.)
Malcolm Potts (Virginia Polytech.)
Robert E. Cannon (Greensboro, North Carolina)
Stephanie Curtis (North Carolina St.U.)
Hans Paerl (Morehead City, North Carolina)
J.M. Shively (Clemson U.)
John R. Banemann (Georgia Inst. Tech.)
David L. Balkwill (Florida St.U.)
Hisato Ikemoto (U.Miami)
Akira Mitsui (U.Miami)

U.S.A. (Midwest)

Roland H. Felkner (Miami U., Ohio)
Jan Jaworski (Miami U., Ohio)
Susan Barnum (Miami U., Ohio)
John Froelich (Miami U., Ohio)
Amitha Wickrema (Miami U., Ohio)
Gerald A. Peters (Yellow Springs, Ohio)
Wayne W. Cammichael (Wright St.U.)
Carolyn Vann (Ball St.U.)
David W. Kroghmann (Purdue U.)
William A. Cramer (Purdue U.)
Marcia Murray (Michigan St.U.)
Jeff Elhai (Michigan St.U.)
Bernhard Schrautemeyer (Michigan St.U.)
C.P. Walk (Michigan St.U.)
Anders Lønneborg (Michigan St.U.)

Steven Gendel (Iowa St.U.)
Florence K. Gleason (Navarre, Minn.)
Nancy Wood (Roosevelt U.)
Herbert Bohme (U.Chicago)
Michelle Wood (U.Chicago)
Bill Burkama (U.Chicago)
Martin Mulligan (U.Chicago)
Teresa Thiel (St.Louis, Missouri)
Himadri Pakrasi (Washington U.)
Robert Webb (Columbia, Missouri)
Rob Burnap (Columbia, Missouri)
Louis Sherman (Columbia, Missouri)
George S. Bullerjahn (Columbia, Missouri)